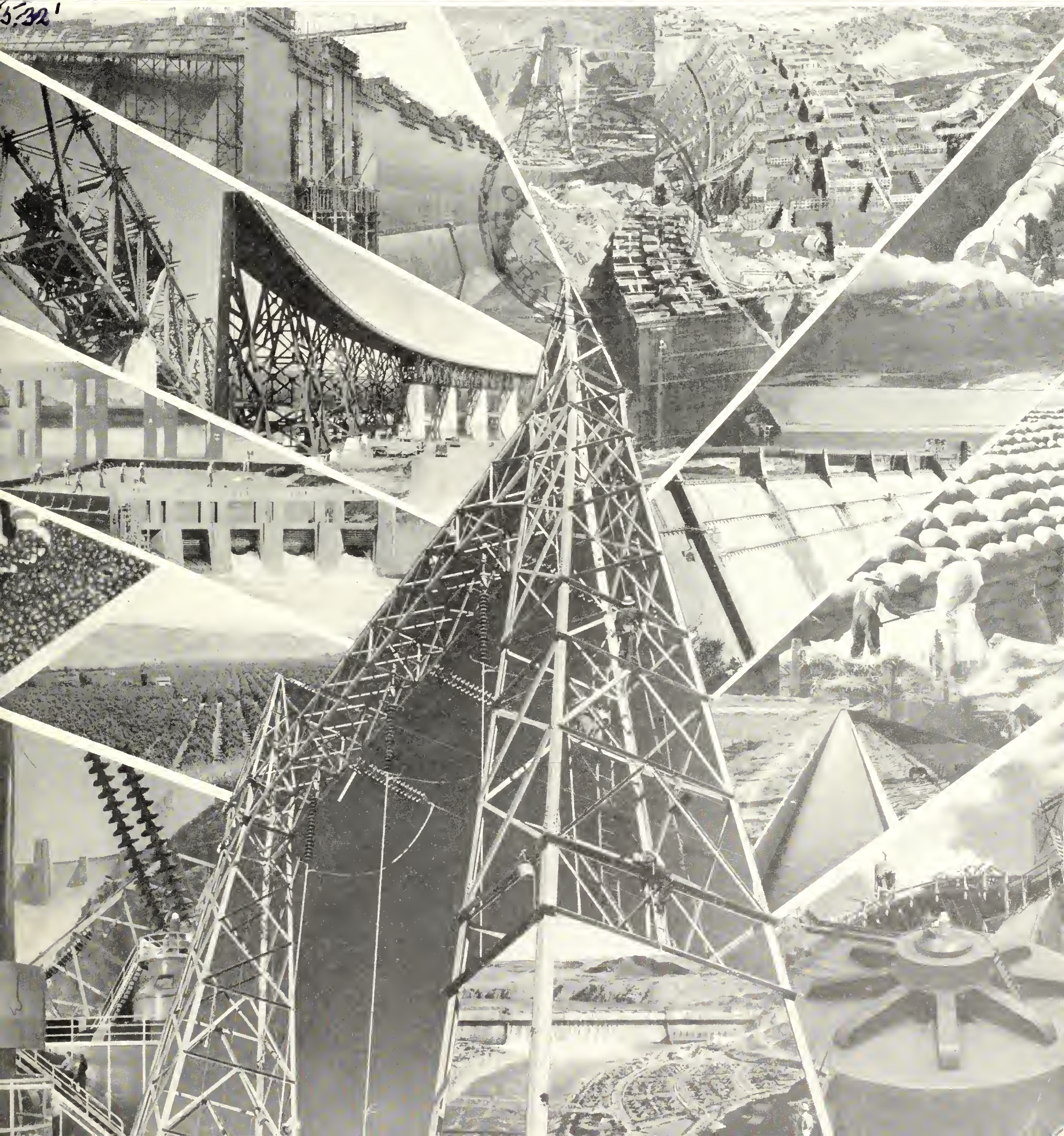
THE RECLAMATION ERA

JANUARY 1942

RECLAMATION REPORTS



WORDS BY
SHANNON ALLEN

Men of Freedom

MUSIC BY
Robt. B. Callahan

Men of Freedom, presented at close of a radio broadcast over Mutual Broadcasting System by the Department of the Interior on November 23, 1941, had so popular an appeal and so many requests for copies that the editors of the Reclamation Era are reproducing the song for its readers. Let's sing its strains as we march to victory.

THE RECLAMATION ERA

VOL. 32 No. 1 JANUARY 1942

INFORMATION PLEASE!

How can THE ERA be made more useful to you?

The editors of the THE RECLAMATION ERA wish that they could sit down with each of the 18,000 readers they serve and discover how THE ERA might be made of greater use to you.

Since that cannot be done, the editors would like to ask the readers for a card, a note, or a letter answering the question.

You will notice that the articles fall into several categories, as, for example (1) those dealing with general reclamation subjects, (2) those dealing with the problems of the irrigation farmer; (3) those dealing with operation and management of irrigation facilities; (4) those telling how reclamation facilities were designed or built; (5) those discussing power, flood control and other multiple reclamation benefits; and (6) special departments, including (a) current news of the month, (b) notes for contractors, (c) articles on irrigation, (d) the picture page, (e) the organization of the Bureau of Reclamation, and (f) the Honor Roll.

Would you like to have more articles of any particular type, or an article on any particular subject, or would you like to tell the editors anything else about the magazine? If so just drop a card or a letter to the Editors, THE RECLAMATION ERA, Bureau of Reclamation, Washington, D. C. And thank you.

THE ERA'S COVER

Reclamation Results—1941

Montage by Kay C. Dimmitt

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Drawing page 5 *Kay C. Dimmitt.*

Key to designation: t.—top; m.—middle; b.—bottom; l.—left; c.—center; r.—right; i.—inset.

CUT ALONG THIS LINE

(Date) . . . .

COMMISSIONER,
Bureau of Reclamation,
Washington, D. C.

SIR: I am enclosing my check [1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

January 1942. (Name) . . . .

(Address) . . . .

. . . .

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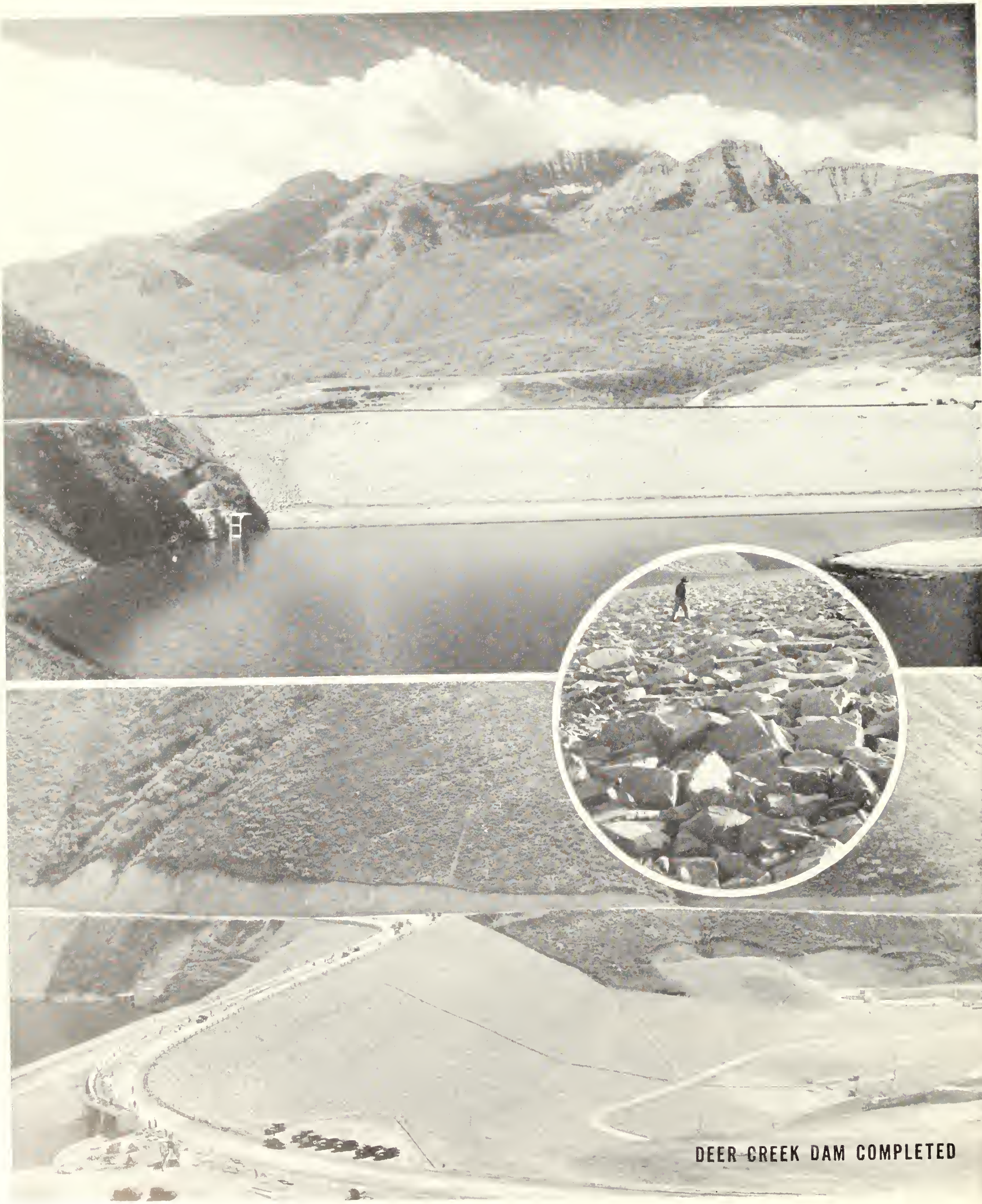


DEER CREEK DAM COMPLETED

Reclamation Reports:

POWER LAND — PEOPLE WATER

THE YEAR 1940-41 recorded a period of intense activity by the Bureau of Reclamation.

Conserving the water resources of the West for the irrigation of more than 10,000,000 acres of thirsty land, making important contributions to National defense, and paving the way for meeting post-emergency requirements and future peace, the Bureau can show concrete results from this activity.

To meet the skyrocketing demand for power for National defense the Bureau speeded up its power production for airplane factories, aluminum plants, and other defense industries. Four new power plants began operations on Reclamation projects during the fiscal year. Installation of additional generating equipment was rushed in order to double existing capacity by 1943. One new project was authorized. A list of 50 potential projects with power possibilities was submitted to the Congress for consideration.

At the close of the year 28 power plants were in operation in 17 projects with a total installed capacity of 953,962 kilowatts—an all-time high exceeding the capacity of all electric plants on the Pacific coast in 1912.

Grand Coulee Highlights Power Activity

High light of the power activities was on March 22 when the first power from Grand Coulee Dam surged over the Bonneville-Grand Coulee transmission line. Two 10,000-kilowatt station service units began operations. Three of the huge 108,000-kilowatt generating units are scheduled to go into operation by February 1942 and three more in 1943, by which time Grand Coulee will rank second only to Boulder Dam as the largest producer of hydroelectric energy in the world.

Boulder Dam's installed capacity of 704,800 kilowatts, or little more than half its ultimate capacity of 1,322,300 kilowatts, will be increased by August 1942 to 962,300 kilowatts with the installation of three additional large units. Power from Boulder Dam is serving the country's airplane manufacturing center in southern California and will furnish power for magnesium plants.

The West celebrated one of its finest water years in a generation, and Reclamation contributed largely to this satisfactory condition. The 73 reservoirs in operation on Reclamation projects on June 1 contained 41½ million acre-feet or 13,000 billion gallons of water. Largest was Lake Mead at Boulder Dam, where storage rose to more than 30,000,000 acre-feet before the end of the fiscal year; later Lake Mead storage rose to nearly 31,000,000 acre-feet, and was spilled. On the Salt River project, Arizona, all five reservoirs spilled for the first time. Their storage had reached the maximum capacity of 1,894,800 acre-feet contrasted with 22,000 acre-feet last year.

Bureau Serves 4,700,000 Persons . . .

With the expansion of its irrigation and power activities the Bureau was serving, at the close of the fiscal year, more than 4,700,000 persons—a population greater than that living in the 11 Mountain and Pacific States when the Reclamation law was enacted in 1902. On 36 projects in operation there were 57,441 irrigated farms on which reside 214,781 persons. In 279 cities and towns created by or which were maintained by the project farms, there was a population of 688,134. More than 20,000 additional farms with a population of around 100,000 persons received supplemental water supplies from project works. Hundreds of churches and schools in the project areas reflect the social influence of the transformation of desert wastes into productive self-sustaining communities.

. . . and 4,168,168 Acres

In 1940 the Bureau was prepared to serve water for the irrigation of 4,168,168 acres—the largest area since its operations began. This area represents an increase of 278,628 acres over that reported for 1939.

The crop returns from the 3,316,030 acres of land in cultivation actually irrigated in 1940 were valued at $117,788,677, an increase of $3,705,883 over the total for the previous year.

Under the construction program in progress 2,370,000 acres of land will be brought into cultivation. The largest development in this program is the Columbia Basin project in Washington, which will irrigate 1,200,000 acres. More than 3,800,000 acres of land now inadequately irrigated will receive more stable supplies through the facilities now under construction, which will bring to about 10,958,000 acres the land to be served by the current program.

Through the water conservation and utilization program, designed to rehabilitate and stabilize the Great Plains area and other western agricultural regions where critical droughts and water shortages have disrupted the economy and caused heavy migrations, the area of 155,000 acres to be benefited will probably be more than doubled as new projects now under investigation are added.

The Bureau's largest construction program pushed forward on 36 projects in 14 States during the year. Of the 17 dams under construction, 8 were completed, which brought to 163 the total number of dams completed by the Bureau since 1902.

Rapidly nearing completion were four other outstanding dams. Two (Grand Coulee and Marshall Ford) were respectively first and fifth largest concrete dams in the world.

Grand Coulee Dam, principal construction feature of the Columbia Basin project, was practically completed. Land classification and appraisal of the 1,200,000 acres to be served by the project were nearing completion. Good progress was made on investigations to plan for the development and settlement of the area, which probably will

Water discharge, Grand Coulee Dam

Irrigation farmer leveling the land of his farm to obtain equal distribution of water

begin in 1944 or 1945 when water is available for the first blocks of lands. Hatcheries were completed at three stations for the conservation of migratory fish in the Columbia River.

The Central Valley project in California, to benefit some 2,000,000 acres of rich and highly cultivated land in addition to providing protection from floods, repulsing salt water intrusions from San Francisco Bay, and generating hydroelectric power, was approximately one-fourth completed. Shasta Dam, on the Sacramento River in the north, was more than half finished; the Southern Pacific Railroad relocation was practically completed with the exception of the high double-deck Pit River Bridge; the contract for Friant Dam on the San Joaquin River in the south was more than 75 percent completed; a 9½-mile section of the 40-mile Contra Costa Canal was completed; and work was begun on the Madera Canal.

With eight of the large 82,500-kilowatt generators and one of the smaller 40,000-kilowatt generators in operation at the Boulder Dam power plant approximately 3,200,000,000 kilowatt-hours of energy were generated and collections by the Government from the sale of electric energy totaled more than $6,000,000, with a maximum of $767,927 in August 1940. The Boulder Canyon Adjustment Act of July 19, 1940, which provided for the adjustment of rates and charges for electrical energy generated at Boulder Dam, was effectuated in May 1941 with the execution of agency contracts and new contracts with power allottees.

Progress on Colorado-Big Thompson Project

In Colorado good progress was made on the Colorado-Big Thompson project, designed to provide a supplemental water supply for 615,000 acres of land. Green Mountain Dam on the Blue River was almost 50 percent completed and contractors finished two sections of the 13.1-mile Continental Divide Tunnel. Two additional sections were under construction.

Marshall Ford Dam on the Colorado River in Texas was being raised to a height of 270 feet with 67 percent of the work completed under a contract let during the year.

The year's work brought the construction accomplishments of the Bureau to impressive totals: 85 storage and 78 diversion dams; 50 power plants; 364 pumping plants; 367 tunnels; 16,017 miles of canals and laterals; 5,931 miles of ditches and drains; 206,043 canal structures; 14,072 bridges; 22,504 culverts; 2,175 miles of pipe; 6,427 flumes; 3,735 miles of roads; and 5,403 miles of transmission lines.

Long needed action was taken by the Congress at the close of the year to expedite the construction of all projects financed from the seriously depleted Reclamation fund by providing that additional projects be financed from the General Fund of the Treasury.

The demand for the construction of multiple-purpose projects under the Reclamation program continues unabated. The increase in population in the West, coupled with the industrial expansion vital to national defense is emphasizing the feasibility of combinations of power and irrigation facilities.

Shelf of Projects Ready for Launching When Needed

By investigation into practically every river basin in the West the Bureau of Reclamation will have on hand a shelf of feasible projects which can be launched quickly to provide employment and new homes for a permanent population in the rural areas of the West and in the urban communities which they support.

No dearth of feasible projects exists. Estimates are that there is sufficient water available in the West to irrigate an additional 22,000,000 acres, and provide supplemental supplies for 11,700,000 acres. Potential water power development, in connection with irrigation developments, would doubtless provide as much as 30,000,000 kilowatts of electric capacity, more than three times the presently installed capacity.

Anderson Ranch dam site, Boise project, Idaho

Built on a Volcano

By LEWIS G. SMITH
Assistant Engineer

Owyhee Dam, highest in the world at completion in 1932, rests squarely and solidly on an ancient crater

HERE IS THE STRANGE case of a volcano that, through a most extraordinary chain of events, eventually made good. Today it shoulders the responsibility for over 14,000 people whose livelihood springs from the soil irrigated by water stored behind mighty Owyhee Dam on the Owyhee Reclamation project in Oregon-Idaho.

Many years ago, long even before the concept of time had been invented to disconcert the human mind, a certain volcano was busily ejecting that which later became designated as a portion of the State of Oregon. Bombs, hot ashes, and cinders were thrown from the volcano's interior. Occasionally liquid lava overspilled its lip. In time, a respectable cone was formed, and the mouth, through successive enlargements by explosions, attained a width of approximately 1,500 feet.

When the volcano's eruptive forces were almost expended, a mass of hot liquid rock welled up. The molten rock overflowed the side of the cone and ran southward for a distance of about 4 miles, but a large quantity ponded in the volcano's throat.

As the upwelling gradually ceased, the fused mass began to cool and to solidify into a dense, durable rock called rhyolite. Although the volcano made repeated attempts to force the molten rhyolite from its neck during the long process of cooling, the eruptive forces met with only partial success. Pressures from below were relieved by minor vents within the less hardened portions. The mass, as a body, could not be dislodged. Eventually, the cooling was complete and the throat of the volcano was effectively blocked.

During the years that followed, the volcano's outer slopes of ashes were easy prey to the forces of weather. As though in eagerness to remove an unsightly pockmark, decay and erosion detruncated a portion of the cone before their efforts were thwarted by other forces.

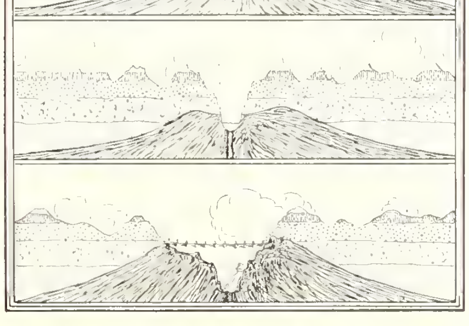
This volcano was only one of many. In succeeding ages, great series of basalt flows from other volcanoes and lava vents in the region were deposited over the remnants of the strangled volcano. It was covered to a depth of several times its height. The volcano seemed entombed for eternity.

But Nature was not done with her task. At some later time, still before there were calendars, a parting of the immense lava layers was caused by a vertical fracture or fault which passed directly through the rhyolite core of the buried volcano. The mass of layers on one side of the fault moved horizontally a distance of about 100 feet in respect to those opposite. The fault zone, approximately 10 feet wide, was filled with fragments of rock that became crushed as the two masses moved past one another.

And, in the course of time, a stream established itself through this fault. It was the forerunner of the present Owyhee River. The stream trenched its way downward and enlarged its channel until finally the rhyolite plug of the volcano became exposed. This same rhyolite mass which had plugged the volcano had become the most substantial rock in the run of the river. Instead of giving way readily to the weathering forces of the river and climate, as did the sections both upstream and downstream from the plug, it remained virtually intact, and confined the river to a narrow gorge, thus forming the so-called box of Owyhee Canyon. The section upstream from the plug, however, was cut not only downward but outward and became to appear so much like a basin that for years it was called The Hole-in-the-Ground.

Ideal Topography for the Dam

Here was ideal topography for a dam and reservoir. The engineers of the Government's Bureau of Reclamation were immediately attracted to this site when seeking to build a dam for storage and diversion of the Owyhee River for use on the Owyhee project. Upon approval of the site by three reputable geologists, the Owyhee Dam, the highest in the world at the time of its completion, was constructed in the volcano's rhyolite cradle during the years of 1928 through 1932.



During the construction of the dam, the engineers discovered the lower extension of the fault that had been responsible for the cutting of the canyon through the hardest rock in the region. In order to insure complete safety of the dam, the entire fault zone within the bounds of the dam was mined to a maximum depth of 150 feet below normal foundations and was backfilled with concrete.

Geological investigations of the proposed dam site prior to construction of the dam had not disclosed definitely that a stream barrier at this site would rest over an ancient volcano, but this was pointed out as a possibility. Such a likely condition was mostly of academic interest and was secondary to the more practical fact that the rock was hard, durable, and well capable of supporting the proposed concrete structure, to rise 417 feet above normal foundations. Not until Dr. Charles P. Berkey, an internationally known consulting geologist and eminent authority on engineering geology, visited the dam in 1935, 3 years after its completion, was the dam authoritatively declared to "rest squarely on a resurrected and partially destroyed volcano."

Dr. Berkey explained that "all of the features on the immediate site of the dam and for a short and somewhat variable distance on either side of the gorge, both above and below the dam, are consistent with such an origin. It appears that the ancient crater wall can still be traced."

The reconstruction of geologic events in this article is substantially as interpreted by Dr. Berkey in his unpublished reports to the Bureau of Reclamation.

What if the volcano should suddenly become active? The chances of this are about the same as for King Tut-ankh-Amen to break his long silence, now that he too has been untombed to the eyes of a much later day. The volcano not only reached a decently permanent death at the time of its being choked by the rhyolite mass, but it has rested through at least three major eras—the destruction of part of the cone by erosion and atmospheric wear; the interment by the lava flows, the full extent of which is unknown; and the exhumation by the Owyhee River. Each of these eras alone approaches infinity when compared with the life span of human beings. While first thought might consider the position of Owyhee Dam precarious, the dam will far outlast the memory of its builders.

Today's Reclamation Program

By JOHN C. PAGE, *Commissioner*

THIS IS A TIME of crisis, a grave emergency involving everyone and every activity in the United States.

I am proud to be able to say that the Bureau of Reclamation recognizing this fact, has been stripped for action.

The demands of today are quite different from those made only a few years ago. Then the building of a great dam acted as a stabilizer as we rolled in economic doldrums. To build such a dam required skilled labor, steel and lumber, and big machines. Now these are needed for the war effort. Unless a great dam directly serves defense, a better use may be found elsewhere for the labor, materials, and machines.

Today the Reclamation program continues to emphasize the historic purpose of making homes to build a better and a sounder West.

Already a million people are being supported by the 57,000 irrigated farms on Reclamation projects. Other projects under way or authorized will provide homes for a million more.

Today the Bureau is prepared to irrigate 4,200,000 acres. The program in progress will bring in 2,500,000 acres more. And more than 5,000,000 acres of land now short of water will get a supplemental supply. This will bring the area served by Reclamation to more than half the entire area irrigated in the West.

Crop returns from Reclamation projects in 1940 were over $117,000,000. The cumulative value of crops produced on land watered by Reclamation projects since 1906 is more than 2¾ billion dollars. This amount, turned into the channels of national trade, is conservatively estimated to have added nearly 18 billion dollars to the national wealth.

It has been said that food will win the war and write the peace. These projects will feed their share and more of democracy's defenders. They will add their full allotment of hope for the starving millions over all the world who await a just peace.

But today power is needed. And today Reclamation, more than ever before, means power.

Seventeen power plants with combined capacities of more than 1,000,000 kilowatts are in operation as parts of Federal Reclamation projects. Last year Reclamation plants produced more than 4 billion kilowatt-hours of electric energy.

A few weeks ago the largest generator in the world went into action. At Grand Coulee Dam 150,000 horsepower was added for war service.

I think that we should be doubly grateful for the dam and the foresight of President Franklin D. Roosevelt and Secretary of the Interior Harold L. Ickes which caused its construction to be started in the dismal days of 1933.

Americans have been thankful for Grand Coulee Dam because during the depression years it consumed the energies of labor from coast to coast. We now have additional reason to be satisfied with this great public work. The construction of the dam kept skills bright and factories in readiness for the emergency now confronting us. The completion of the powerhouse meets just in time the rising curve of our need for energy.

The day will come when inevitably there will arise still further reason for thanksgiving. Machinery and men now employed in defense industry will find work building the irrigation system. And, far more important, these American workmen and returning soldiers and sailors will find homes on irrigated farms of the project.

Grand Coulee makes a convenient illustration, since its first great generator so recently began its vital work, but others of our projects, many of them, serve in their degrees as well.

If the wisdom of multiple use of the western water resources, which creates power, as well as homes, farms, and food; if the desirability of this wise Reclamation policy needs further demonstration, that demonstration is now being given.

The Undying Strength

This is the undying strength of multiple-purpose use of our western water resources. Multiple-purpose projects serve in peace or in tribulation; they make their contributions whether the national income is high or low; and they are the hope of the victims of readjustment whether those who seek the new opportunities are war workers whose task is done, or whether they are drought refugees.

This strength is ready for use, and nowhere can more power be made available in this emergency in so short a time. Grand Coulee and Boulder Dams stand ready to receive additional generators just as swiftly as they can be installed.

These, with other Reclamation dams, will provide 553,000 additional kilowatts by December 1942, and a year later will add 835,000 kilowatts more.

And I might add that nowhere, by any other known method, can new power capacity be supplied at such a low unit cost as by making additional installations at these big dams.

The Bureau of Reclamation this year cast up totals of potential irrigation and power projects. This was done in order to see what the future of the West might hold. It was done in order to determine how many acres might yet be reclaimed by feasible projects for the expansion of the West, and how much defense aid could be rendered by the incidental hydroelectric power.

The tremendous total of 9,000,000 kilowatts could be supplied by the construction of Reclamation projects. This new power capacity under favorable conditions could be made available year by year, and completed in 1947.

Nearly 20,000,000 acres are now irrigated, about 2,500,000 acres additional will be served by projects under construction, and about 20,000,000 acres more, apparently, can be irrigated before all western waters are beneficially used. In my opinion that means that the West is less than one-half built today. We are but laying the foundation for the mighty edifice that will rise there in the future.

These foundations must be solidly built and broad enough to support the structure which will be devised by this and succeeding generations. It might be well to pause here and to examine the stability of our base for it should never be forgotten that irrigation, correctly done, is a permanent improvement. Thousands of years ago fields were watered in Africa, the Near East, and Asia. Great civilizations have grown from them and they still produce their crops. Irrigation here is new. Thousands of years from now, if we do well our tasks, this work still will be nurturing our culture.

I repeat, let us examine this foundation. Let us look, for example, more closely at the 20,000,000 acres now being irrigated. Of these more than half, 11,000,000 acres, now require or soon will need more water than existing irrigation systems can supply.

Hundreds of established agricultural areas and the cities and towns they support face stagnation because of inefficient or improperly designed and planned irrigation systems. The homes and livelihoods of millions of people are in danger unless steps are taken to remedy these deficiencies.

The Bureau of Reclamation, through one phase of its program, is coping with this problem. Already 1,900,000 acres, now partially watered, are receiving reliable supplemental supplies through Federal works, and projects now under construction or authorized will rescue 5,200,000 acres more.

But this still leaves 6,000,000 acres yet to be taken care of. It is a problem which must be faced.

There is probably as large a proportion of

arable land in the West as in other sections. But that land is valuable for crop production only when served with irrigation water. The terrible paucity of the total water supply which in the end will limit the West's farmland to little more than 40,000,000 out of 700,000,000 acres demands the most efficient utilization of the water and the land. The waste of precious water truly is a sin. When it is wasted through the soil by overirrigation, it is doubly sinful since then it mines the soil as well.

The Soil and Moisture Conservation section of the Bureau of Reclamation is the spearhead of a new attack on wasteful irrigation practices. We plan aggressively to push a campaign for the measurement of irrigation water, for example, and for the lining of leaky ditches.

It has become clear also in recent years that it is not enough to provide opportunities through building irrigation works.

The day when it took two or three crops of settlers, each leaving the residue of its labor behind to subsidize the next, to develop irrigated land, I sincerely hope is gone forever.

By adequate planning, cooperation with other governmental and nongovernmental agencies, large-scale land leveling and the like, the Bureau of Reclamation can place its settlers in position to succeed by their own efforts. The joint investigations of the Columbia Basin project are a remarkable pioneering effort to this end. Such studies, cut to fit local needs, will be undertaken elsewhere.

Partners—Power, Irrigation

In the edifice of the irrigated West of tomorrow, power might be likened to a cornerstone. Aside from the vital contribution our hydroelectric plants are making today to national defense, power has its own significance in irrigation work. Without the financial footing of power, the Colorado River would have rushed unbridled through Black Canyon, Grand Coulee Dam and the Columbia Basin project would have remained a dream, there would have been no Colorado-Big Thompson project, and the farmers of the San Joaquin Valley of California would have continued to despair of the future. Or if, on the other hand, by some remote chance these projects came to construction, our irrigation farmers would have been burdened by the impossible load of repayment charges. The $7,300,000 of gross revenues returned from the sale of Reclamation power last year is but a token of payment on the annual future return. This return will help liquidate the irrigation costs of many of our multiple-purpose projects and power must, like irrigation, be made to bring broad public benefits.

Power has full partnership in Reclamation. Power must not be hamstrung in shouldering its responsibility of bearing a fullsome share of repayment by control of its distribution by monopolistic interests. When steam plants and transmission lines are necessary to carry out this responsibility, they must be built.

ON DECEMBER 5, 1941, the Bureau of Reclamation presented a 45-minute television show over the Columbia Broadcasting System's New York station. Using models, maps, photographs, motion pictures, and other visual aids, the presentation was designed to show the place of Reclamation in the conservation and defense programs. This marked another important first, the first time representatives of the Department of the Interior had worked before the telecasters. Below are scenes from the telecast. William E. Warne, Chief, Information Division, is telling Bob Edge, Columbia's television announcer, where Reclamation works while the "camera" examines a map. The inset shows Edward H. Heinemann, Engineering Division, explaining the Central Valley project

The water users and the power consumers must not be made to pay excessive charges for their irrigation water and their power because of our negligence to protect them.

And while speaking of finances, I call your attention to the importance of maintaining the integrity of the Reclamation repayment principle. It is our boast that every repayable dollar expended for irrigation will be returned to the Reclamation fund. When we abandon that, our structure will begin to crumble.

Just as it serves today in the emergency, the Bureau of Reclamation will do its part in the post-war era. It is prepared for this.

Armed with the legislative authority conferred by the Reclamation law, the Reclamation Project Act of 1939 and the Water Conservation and Utility Act, the Bureau stands ready to move promptly and effectively. Through secondary investigations, it will have available a five-foot shelf of potential projects. The investigational funds, supplied at an unprecedented rate, are being put to use in every western State. Despite severe difficulties in getting qualified men for this work, good progress is being made.

A year of good water was experienced in 1940 in the West. Only 22,000 acre-feet of storage remained in 1939 in all the great system of reservoirs serving the Salt River project. The long drought was tragically near to bringing Central Arizona to its knees. But it began to rain, and it rained and it rained. Every Salt River project reservoir spilled in 1940. There is plenty of water now.

I do not know what causes these drought cycles. I do know, however, that droughts, severe ones, will come again and again. They will sweep the Great Plains and the West.

A few weeks ago the North Dakota Reclamation Association held it first annual convention. The slogan was: "Don't Forget the Drought." In a year of abundant rainfall, the northern Great Plains representatives have not failed to remain alert to the disastrous years of the great drought of the last decade.

If we are to avoid the heartbreaks, the economic waste of uprooted families and succeeding crop losses of dry-land farmers, we must build sensibly. We must not base our

See RECLAMATION, *page 15*

John Wesley Powell

Pioneer Conservationist

By W. G. HOYT, *Hydraulic Engineer, U. S. Geological Survey*

BACK of motivating forces which have culminated in popular movements are to be found original sources of inspiration, the minds of individuals. In the field of natural science relating to the conservation of land and water loom the ideas and personality of John Wesley Powell.

More than 70 years ago Major Powell recognized the interplay of complex forces at work in carving the earth's surface and, perhaps what is more important, he foresaw the effect of man's interference with those forces and the necessity for adapting man's activities to those forces. In the background of the present-day land and water conservation movement looms the personality of this great pioneer.

Powell had contemporaries and followers possessing a breadth of vision and ability to make broad searching scientific deductions similar to his own. The works of Powell and his contemporaries King, Hayden, and Wheeler gave us our first appraisal of the vast resources of the West. Powell, however, was among the first to realize the necessity and value of the wise use of these resources. It can be said that the moving force which culminated in the first Nation-wide conservation movement of 1901 was Major Powell, and his influence still was felt in the reanimation of the conservation movement in 1933.

It is perhaps not by accident that before a visitor to the museum in the Department of the Interior Building in Washington gets his first glimpse of the elaborate dioramas, models, and pictures depicting conservation activities, he first sees paintings of the King, Hayden, Wheeler, and Powell survey parties.

Geologic Investigations

Clarence King, a geologist, under authority of the Secretary of War during the period 1867 to 1872 examined, mapped, and described the geologic structures, geographical conditions, and natural resources of a belt of country extending from the 120th meridian eastward to the 105th meridian along the 40th parallel. F. V. Hayden, a physician who had become interested in geology and topographic mapping, under the authority of the Secretary of the Interior during the period 1867 to 1879 conducted field surveys throughout the West in connection with the preparation of a series of geographical and geologic maps embracing each of the territories. Dr. Hayden was well qualified for this work by reason of his rather extensive geologic investigations in Nebraska and the Dakotas during 1855, 1856, and 1857. Lt. George E. Wheeler, an engineer officer, War Department, under authority of the Secretary of War during the period 1871 to 1879 undertook a mapping program of the entire region west of the 100th meridian looking toward the preparation of topographic maps which would be useful in military operations and administrative problems. Maj. John Wesley Powell, a student of botany and geology and a veteran of the War between the States, under the direction first of the Smithsonian Institution and later of the Secretary of the Interior, during the period 1869 to 1878 explored the canyons of the Green and Colorado Rivers and carried out a program of topographic, geologic, and geodetic mapping and land and water classification throughout much of the intermountain and plains area.

Although the achievements of King, Hayden, and Wheeler were outstanding, Powell perhaps looked farther beyond the work on which he was engaged, to visualize the needs and problems of the up-building of the West. He saw clearly the complex relations existing between land, water, and climate, the necessity for factual information relating to them, and what was perhaps more important, he, along with King, stressed the necessity for adapting economic development to natural conditions, since without such adaptation, efforts of man result only in unhappiness for himself and in injury to his hoped-for habitat.

Although his reports written in collaboration with Gilbert and others, dealt most extensively with the arid lands, Powell pointed out clearly that many droughts and many fruitless seasons in long series of years would be associated with agricultural development of the subhumid plains area, which he defined as extending from the 100th meridian eastward to the 28-inch isohyetal line—actually, since Powell made his deduction, crop failures in the Great Plains have occurred one out of every 3 to 7 years, depending on the particular area involved. In these plains areas he foresaw that eventually the agriculture of vast regions would have to be stabilized in coordination with limited irrigation—a step now coming to pass. At the time, however, his report "roused a storm of indignation, because it characterized as semiarid the middle belt of the plains toward which settlement was then tending." As to arid lands, he pointed out many important hydrologic relationships, set forth many of the outstanding engineering problems that would have to be considered in irrigation development, and discussed legal and financial problems that would have to be given consideration in any successful development enterprise. He pointed out that in the arid region agriculture would be largely dependent upon irrigation, that the amount of land was far in excess of the amount of water and that only about 2.8 percent of the arid lands could be irrigated. This statement was originally widely discredited. At the present time, however, only about 19,000,000 acres or 3 percent of the lands receiving less than 20 inches of rain annually are under ditches.

Powell indicated that precipitation alone was not a limiting factor but that "where the temperature is greater, more rain is needed. Where the temperature is less, agriculture is successful with a smaller amount of precipitation"—the nucleus of the modern climatic index. He pointed out the necessity for making continuous daily or even hourly observations of stream stage, and discharge, for a series of years for each stream—a step now realized as absolutely essential in any water utilization problem; that the complete development of irrigation would depend on the use of the major streams; that small streams should not be so utilized as to interfere with the use of the major stream; that on account of loss by evaporation, reservoirs should be located in headwater areas; that the greatest storage of water must come from great reservoirs in the highlands where lateral valleys may be dammed; that the development of the major streams would require cooperative labor and capital; that the right to the water necessary to irrigate any tract of land should adhere in the land and the water right should go with the land title and that priority of use should secure the title rights.

Fields of Achievement

Powell's interests were by no means restricted to a single subject. At the time of his death he had achieved fame in four fields. He was a soldier, an intrepid explorer, an outstanding geologist, and a pioneer in the field of American Ethnology. In each, his name is stamped in the indelible ink of achievement. In the field of land and water development and conservation he stands a seer verified by the years.

Powell enrolled as a private in Company H, Twentieth Illinois Infantry Volunteers, on May 8, 1861, was commissioned a second lieutenant in June, a captain in December of Battery F, Second Light Artillery. On April 6, 1862, while in action with his company at Shilo he lost his right arm. Following recuperation he entered active service in March 1863 and on November 4, 1863, was designated Chief of the Artillery of the Fourth Division, Seventeenth Army Corps. He served with distinction as a major in various capacities and was mustered out on January 4, 1865.

As an explorer Powell solved the greatest geographical problem in the United States of his day, namely the mysteries of the Green and Colorado Rivers between Wyoming and Arizona. In 1869 he successfully navigated for the first time the tortuous and dangerous canyons between Green River, Wyo., and the mouth of the Virgin River. Failing to reach the desired objective on the first trip, mainly because of loss of equipment, he made a second voyage through the canyon in 1871, exploring as far downstream as the mouth of Kanab Creek.

As a geologist, G. K. Gilbert says in part of Powell in 1903: "His chief contributions are three in number—a classification of mountains, a classification of processes of land sculpture, and a classification of stream valleys. * * *

He announced the fundamental principles of control in the sculpture of the land, crystallizing his central idea in the new term *base-level*. He introduced a group of explanations of the relations of waterways to mountains and ridges, accompanying the new ideas with three new terms—*consequent valleys*, *antecedent valleys*, and *superimposed valleys*."

As an ethnologist Powel gave the work on American Ethnology "a definite purpose, conformable to high scientific standards," whereas formerly it had been "discursive, unorganized, and to a large extent dilettante" (Gilbert). Starting in his early years with a study of inanimate nature, Powell passed on to the study of man. His exploration work in the West brought him in touch with the Indians and the ethnologic investigations thus begun led him into the study of anthropology. He was president of the Anthropological Society of Washington and created the Bureau of Ethnology.

Although neither a hydraulic engineer nor a hydrologist, many who follow these professions today read with profound admiration Powell's terse dicta relating to fundamentals of land and water. In the words of Gilbert, "He dealt with the complex problem of the subjugation to human use of the arid portion of our national domain, and he brought to bear on it the scientific data of climatology and sociology as well as geology."

In 1874, 5 years before the creation of the Geological Survey, 7 years before he became its director, and nearly 70 years before "Planning" became a byword, he outlined essentials for wise land and water utilization, from a national standpoint, namely, classification to determine (1) the general topographic features of the country such as mountains, water courses, and bodies of water; (2) the amount and distribution of land susceptible to irrigation; (3) the amount and distribution of pasture lands; and (4) the amount and distribution of timber lands.

A Man of Vision

In 1878 his classic report on "Lands of the arid region"[1] containing drafts of two bills, one relating to the organization of irrigation districts and the other relating to the organization of pasturage districts was submitted to the Congress. In the drafts of these two bills were the germs of ideas which eventually led to the Reclamation Act (in 1902) and the Taylor Grazing Act (in 1934), two of the several major conservation acts relating to land use now administered by the Interior Department. Powell's report on the lands of the arid regions of the United States as well as his later reports, are far more than compilations of statistics. In them he described not only the character of the land comprising the vast public domain but also the engineering problems involved in their redemption and use and made suggestions for the legislative action necessary to inaugurate the enterprises by which the lands might "eventually be rescued from their present worthless state." In making his observations he drew not only upon the experience of the hardy Mormon pioneers who for 30 years had been practicing agriculture by irrigation, on which the success of their colonization in Utah depended, but also made numerous profound deductions based on his own observations. Powell was a man of vision without being visionary.

During the early eighties, irrigation development in much of the West had reached a static stage and most irrigable lands within easy reach of many of the streams had been developed to the extent of available, unregulated water supply. Powell's reports pointed out what could be done toward a more efficient utilization of water resources and made a profound impression on the Congress. At his suggestion Congress appointed a commission to study the physical and economic conditions of the arid region with a view to modification or reconstruction of its land laws and Powell devoted 2 years to the work of this commission.

On March 27, 1888, the Senate directed the Geological Survey, which, following the recommendations of the National Academy of Sciences had been created by act of March 30, 1879, to investigate the practicability of constructing reservoirs, to classify the public lands, and to furnish maps showing the various divisions of the public domain suitable for agriculture and irrigation, and to designate places for reservoirs, canals, and other hy-

[1] Report on the Lands of the arid region of the United States by J. W. Powell, H. R. 45 Cong. 2d Sess., Ex. Doc. 73 Government Printing Office 1878.

Start of Powell's second expedition near Green River, Wyo., May 1871
Major Powell is the dominant figure on the *Emma Dean*, center boat

draulic works, an undertaking which at that time embraced a survey of about a billion acres of land. Powell at that time was Director of the Geological Survey, having followed Clarence King, its first director, who resigned on March 11, 1881.

With the initial appropriation of $250,000 an irrigation survey of the West was made possible. The magnitude of this appropriation at that early date reflects the appreciation of Powell's precepts that classification of lands and reliable records of water resources were essential to the proper development of the West.

The act creating the irrigation survey also directed the withdrawal from entry of lands suitable for reservoir sites and for irrigation, marking a milestone in the attempt by the Federal Government as a landlord to dedicate its lands to their highest use rather than to indiscriminate disposal. The policy of discriminating use naturally met opposition from those who were accustomed to and were benefited by the earlier practice.

The beginning of extensive classification by the Geological Survey with respect to water in 1888 may also be considered as the direct forerunner of the Federal Reclamation Act passed in 1902 (the year of Powell's death). Following the early survey reports backed by Powell's dominant personality, there was a growth of public sentiment which made itself felt in annual irrigation congresses and finally in the Congress of the United States.

The irrigation survey involved the investigation of the possibility of irrigation in an area comprising nearly half of the United States. In a short time Powell organized within the Geological Survey two divisions, one a topographic survey and the other a hydraulic survey. Into the newly acquired personnel making up the staff of the hydraulic survey, the forerunner of the present Water Resources Branch of the Geological Survey, came Frederick Haynes Newell and, later, in 1894, Arthur Powell Davis, a nephew of Powell.

Powell's Heirs in Conservation

These men became the heirs of Powell's ideas and enthusiasm for conservation. To Newell, Major Powell transferred the task of organizing systematic work by the Federal Government in the study of water and in making available to the public the essential facts relating to the amount and utility of water. He must also have transferred to Newell his boundless ambition to make the West a happier place in which to live, for Newell, like Powell, became a man of vision, an organizer of personnel and a continuing source of inspiration to those who worked with him. He, like Powell, visualized the value of water in the economic development of the country and he initiated and developed in the Geological Survey the systematic study of its chemical quantity and quality as related to its utility in agriculture and industry. He was chief of the party that established in 1888 the first regular gaging station on the Rio Grande at Embudo, N. Mex., the forerunner of a Nation-wide series of stations that has since grown to over 4,000 at which 65,000 station-year records are available. Under his leadership systematic studies were started of ground water and today some 75,000 observations of ground-water levels are made annually by the Survey. He initiated Nation-wide studies looking toward wise and efficient utilization of water for power and domestic purposes as well as for irrigation. In addition to the supervision of these large investigational programs he, along with Powell, kept the national reclamation idea in the foreground by attending and presenting papers at the 10 national and international irrigation congresses held during the period 1891 to 1902.

Powell's boat, with the armchair, in the Grand Canyon

F. H. Newell, First Reclamation Director

Finally, hopes were realized when, through the powerful influence of President Theodore Roosevelt, the Reclamation Act was ready to be signed on June 17, 1902. That Newell influenced the initiation of the conservation program is indicated by the following statement made by Theodore Roosevelt: "For 14 years I have followed at first hand the work of Mr. Frederick H. Newell. * * * I first came in touch with him when I was Governor, when I drew on him for aid and advice in forming a proper conservation policy for the State of New York. During the years I was President, he was one of my right-hand men. * * * He is a public servant of whom it is the bald and literal truth to say that by his services he has made all good American citizens his debtors."

Newell was appointed chief engineer of the Reclamation Service with the Geological Survey. He filled the position with distinction during the period 1902–07 and became the first director of the Reclamation Service upon its formal organization as a separate bureau of the Interior Department.

A. P. Davis the "Builder"

The reclamation plan of Powell, Newell, and others could not have become an actuality without the services of a "builder." It is perhaps significant of a distinguished family heritage that a nephew of Major Powell was chosen for this important position. Arthur Powell Davis transferred from the Geological Survey to the Reclamation Service as chief engineer under Newell and of him it is truly said that he was one of the Nation's outstanding builders. He was responsible for the construction of the Shoshone and Arrowrock Dams, each in turn, "the highest in the world," the Elephant Butte Dam, and in fact most of the monumental dams, tunnels, and permanent structures built by the Reclamation Service throughout the period 1907 to 1922. Even those built as late as the 1930's bore his imprint. Secretary of the Interior Ickes refers to Davis as being the "father of the plan" for the first major multiple use project, that of Boulder Dam on the Colorado River, which in 1869 Powell first navigated. It is of interest to note that Davis dedicated his book Irrigation Works Constructed by the United States Government, published in 1917, to "John W. Powell, the farseeing philosopher; Francis G. Newlands (author of the Federal Reclamation Act), the constructive statesman; and Frederick H. Newell, the faithful administrator, the pioneers who blazed the way for the beneficial work of national reclamation."

Others carry on the reclamation work where these early leaders left off, but as Theodore Roosevelt once said of Newell, we may today say of them, they "made all good American citizens their debtors."

STRUCTURES on Reclamation projects include 367 tunnels.

THE EQUIVALENT of a train spread from coast to coast, with a thousand miles left over, was required to transport the gravel and sand for the concrete contained in Grand Coulee Dam.

Tucumcari Tunnel Construction

By H. E. ROBINSON
Associate Engineer

THREE TUNNELS totaling 20,131 feet in length are a part of the Conchas Canal, a principal feature of the Tucumcari project in New Mexico.

The three tunnels under the present contract, Nos. 1, 2, and 3, are 2,500, 7,931, and 9,700 feet long, respectively, horseshoe-shaped, 11 feet, 6 inches in diameter, and concrete-lined. The contract for their construction, which includes both boring and concreting, was awarded to the Jahn-Bressi-Bevanda Constructors, Inc., of Los Angeles, Calif. Work was started March 17, 1940.

The maximum distance from tunnel No. 1 to tunnel No. 3 is approximately 20 miles, so a central camp was constructed by the contractor at the outlet of tunnel No. 2, from which place all work is being carried on. This camp consists of a general office and warehouse buiding, a general store, a restaurant and recreation hall building, 14 two-room apartments, a trailer camp location, a camp laundry and shower bath building, and a playground for the children. A power plant consisting of two 187-kv-a., 3-phase, 60-cycle generators driven by two 225-hp., direct-connected Fairbanks-Morse Diesel engines, supplies power and lights for the camp and also for driving tunnel No. 2. Water is pumped from a well on the South Canadian River, a distance of 8,000 feet, to a 22,000-gallon storage tank located on the mesa above the camp. A sanitary sewer serves the camp, the sewage being disposed of by means of two covered and interconnected sewage-disposal pits located approximately 1,000 feet below the camp.

Through Famous Bell Ranch

This little community has an historic and colorful location, the Bell Ranch.

Thirty-eight miles of the Conchas Canal, including the three tunnels, lie wholly within the boundaries of the old ranch, the property of The Red River Valley Co., comprising 475,000 acres of land upon which graze thousands of head of cattle and a roundup remuda of 300 saddle horses. Ranging unmolsted among the stock are hundreds of antelope, for the entire ranch is a game preserve. Deer, also, are frequently seen along the cedar breaks by the early-morning construction crews. Desert quail abound everywhere.

The manager of the ranch told me, "The Bell Ranch was established on two contiguous grants of land, the principal one of which is known as the Pablo Montoya Grant, from the name of the grantee to whom it was conveyed by the Spanish provincial authorities in 1824.

"Montoya's petition to the Most Excellent Deputation of the Territory of Santa Fe was granted on the 20th day of November 1824.

"Although the report of the deputation on the petition certifies that '. . . The petitioner has sufficient stock to occupy the land he solicits . . .,' it is difficult to believe that such was actually the case. Although the Territory of Santa Fe had been a pastoral country for 200 years before that time, the distance of the land granted from the then existing settlements and the prevalence of marauding Indian tribes combine to make it very improbable that it was thus stocked. When the area of the grant was determined in 1871 by United States Government surveyors, it was found to contain no less than 655,468 acres.

"The late Wilson Waddingham, after this territory became a part of the United States, became possessed of virtually the entire interest not only in the Pablo Montoya Grant, but also in the adjoining tract known as Baca Location No. 2.

"On these properties he established at various times several cattle ranches, of which the most important used the brand of a bell on the left ribs. The date of the establishment of the Bell Ranch was 1872, according to the best information available. In 1884 and 1885 the property was enclosed in a four-strand barb-wire fence 143 miles long. The Red River Valley Co. was organized to control the ranch in 1899. This organization found itself in possession of 22,000 cattle, exclusive of calves, and 1,000 horses, and 719,000 acres of land. This area has been reduced by disposing of several minor portions from time to time."

It is across this ranch that the Conchas Canal is being constructed.

The tunnels are a part of the 70-mile long canal which will convey water from the Conchas Reservoir to the Tucumcari project, Quay County, N. Mex. The area is an uneven plain from which mesas rise up to 500 feet. These mesas are the result of cloudbursts which have eroded all the areas not capped by hard formations, and consist chiefly of horizontal beds of shale and sandstone, the predominating formation being horizontal beds of red shale in varying degrees of hardness and in every case capped with a layer of harder sandstone. It is through these mesas that the tunnels are located.

The tunnel contract also includes 2,260 feet of canal excavation adjacent to the inlet and outlet portals. Of interest in the open-cut excavation was the attempt to take care of the water falling on the slopes above the portals by leaving berms of varying widths at 20-foot intervals in elevation. Drainage ditches, collecting and diverting the water to points beyond the cut, were dug in the berms. It is believed that these precautionary measures against excessive erosion will prove adequate.

Inlet portal of tunnel No. 1, showing berms for protection against storm waters

Two Tunnel Headings Worked Simultaneously to Save Time

The time allowed for boring the tunnels necessitated working two headings simultaneously. Tunnel No. 1, having the shortest completion time, was started first. A power plant similar to the one at tunnel No. 2 was erected at the inlet end which furnished electric power for driving and lighting. A tunnel superintendent was in charge of each tunnel. Similar methods were employed. Differences in results arose principally because of the difference in ground conditions.

In all three tunnels the full face was drilled at once. In tunnel No. 1 a standard design of track-mounted jumbo was used, while in tunnel No. 2 the drilling platform was built on the mucking machine. The latter type had its disadvantage, in that the platform area was inadequate, both for drilling and timbering. It had its advantage, however, in that no time was lost between the various boring cycles, as the mucking machine was immediately converted into a drilling jumbo upon completion of the mucking operation. Both jumbos carried all the posts and bars necessary for the mounting in any desired position of four automatic DA-30 drifters. Air was supplied from the powerhouse through a 4-inch OD pipe line laid along the side of the tunnel and connected with dresser couplings. Water for drilling was supplied from the Conchas Dam town site waterworks system for tunnel No. 1, and from the contractor's waterworks system for tunnels Nos. 2 and 3. It was piped into the tunnels

See TUCUMCARI, *page 18*

Preparation for
Colonizing an Inland Empire

[Information on classification and appraisal of Columbia Basin land may be obtained free on request from the Coulee Dam office, Washington]

By S. E. HUTTON, *Regional Information Director*

GRAND COULEE DAM—the largest masonry dam in the world—has been completed, and the Columbia Basin Reclamation project—the largest single irrigation enterprise in the world—can now follow.

The problem of permanently settling the Columbia Basin's inland empire with farms, homes, and towns is complex. It is under intensive study.

The first requisites of successful settlement—adequate water and suitable land—are available. The Columbia River provides abundant water, not only for irrigating the land but also for generating power for pumping.

The vast empire to be irrigated is spread over 2,500,000 acres extending from Soap Lake, 100 miles from the Canadian border, almost to Oregon. The soil has been examined, classified, and appraised. Nearly half, 1,200,000 acres of land in all, has been found feasible of irrigation.

The problems of settlement and use include some of fundamental importance to the Bureau of Reclamation, some of importance to both the settlers and the Bureau, and some of importance to the settlers alone.

Obviously, any matter which influences the settler's ability to repay construction costs and to pay operating and maintenance costs, and any action or practice of the settler that damages the land and impairs its value are of interest to the Bureau. The Government will have the same interest in the settler's success that any altruistic creditor should have.

Given water and land, the settler must get them into production. This gives rise to problems of farm lay-out, clearing, leveling, ditch-making, crop selection, irrigating, and marketing, all to the best advantage. The farmer must have capital or credit, equipment and stock, shelter and domestic water, access to market, schools for his children, and means for concerted action with his neighbors.

Recognizing these requirements, the Bureau with the assistance of numerous Federal, State, educational, research, and community agencies has organized a series of investigations of land-settlement and land-use problems under the direction of Dr. Harlan H. Barrows of the University of Chicago and William E. Warne of the Bureau of Reclamation. Twenty-eight specific problems are formulated.

It is not possible to arrange these problems in any single series of dependent sequences, for complicated interrelations exist between them.

Six Groups of Problems

Neither is it possible to classify the 28 problems into a few exclusive classes of problems. Roughly, they deal with (1) making the farm ready for production, (2) farm operations, (3) marketing, (4) finance, (5) limited governmental control of the land in the common interest, and (6) community problems.

The first problems in making a farm ready for production have to do with the design of the farm. Committeemen on problem 6 are inquiring into the optimum sizes of farms on various kinds of soil, in the various sections of long or short growing seasons, and with different crop combinations. The report may make it evident that for the single fixed maximum farm size specified in the 1937 antispeculation law (40 acres to a single person, 80 to a couple), limits adapted to circumstances should be substituted.

Abandoned dry farm in the Columbia Basin

Problem 7 inquires into the need and desirability of providing small tracts for wage-earning families. Obviously, conclusions and recommendations must bear some relation to the kinds of crops raised in a district, and to prospective part-time employment there.

As a matter of economy in farm ditch layouts and operation, farm boundaries should bear a rational relation to contours, and, in some districts, should not adhere to the conventional section and subsection lines which now fix ownership limits. Problem 8 deals with this subject, and the committee in charge has made recommendations as to which areas are to be affected, and as to means of dealing with ownership problems in subdividing lands on a topographic basis and regrouping parcels in farms which will lie across conventional boundaries.

With both the economic and social consequences in mind, the committee on problem 10 has made a study of the advantages and disadvantages of grouping settlers' homes in small communities, as is common abroad, rather than isolating each family on its own farm.

Potable Water a Necessity

Closely related is problem 22, which has to do with potable water supplies, particularly with underground water sources. It is desirable to avoid the necessity of keeping canals filled throughout the nonirrigating season for the purpose of furnishing water for stock and for domestic uses, and it is hoped that other sources of adequate water will be found. In a few parts of the project area, well water is procurable only at great depths, so wells are very expensive. Consequently, it may be necessary to group several farmsteads about a single well in order to minimize domestic water costs. Economy in road lay-outs and in electric distributing systems may also influence farmstead grouping.

A study of essential farm improvements and equipment, and of efficient and least expensive means of securing them has been undertaken under problem 9. The report is expected to deal with clearing, leveling, ditching, buildings, water supply, and cooperative

efforts in farm improvements, in connection with standards-of-living studies.

In connection with farm operations, studies of farm practices elsewhere under similar conditions (problem 1), studies of farm economics adaptable to various sections of the Columbia Basin project area (problem 2), and studies of water requirements for various combinations of soils and crops (problem 4) have been undertaken.

The committee on problem 1 has made very thorough studies of crop practices on specific farms, over a period of years, on a number of northwest irrigation projects where conditions resemble those that will exist on the new project, and has attempted to determine combinations which have, and combinations which have not been successful. A second committee (problem 2) has undertaken to formulate recommendations of combinations of crops, farm practices, soils, climate, and prospective markets that are likely to be successful in various parts of the new project.

Water Duty Studied

With economy of operation, the preservation of soil fertility, and good crop yields in view, the committee on problem 4 is making a study of the duty of water on various soils and crops. The primary objectives are to make the cost of pumping and distributing water a minimum, and to protect the soil from leaching, erosion, and water-logging.

Markets and access to markets in which to sell and buy are the basis of a group of studies covering the project's needs for towns, roads, and railroad extensions, the possible benefits from the navigation of the lower Columbia, and feasible processing and manufacturing plants in the area, as well as a study of local and distant markets for the products of the project. Problems 18, 19, 20, 21, and 24 deal with these specific subjects. In addition, a special study of market outlets for products of the project area has been undertaken. Estimate of probable consumption, based on expected population increases, and estimates of future farm production have been made for the eight Western States which comprise the primary market area for the project.

The distribution of the costs of the Grand Coulee Dam and the irrigation system among their beneficiaries will affect the construction charges to be paid by settlers. Since downstream power plants will have their firm power capacities greatly increased, and the navigability of the lower Columbia will be improved by water released from the storage reservoir in winter, the committee on problem 11 has made inquiries into the value of such benefits and means of distributing equitably the cost of the dam to power, navigation, and flood control.

A precedent for the proposal made in problem 12, that nonrural settlers on the project should share in the costs of the project development, exists in the arrangements made for recovering the cost of the Colorado-Big

Irrigable land in the Columbia Basin

Thompson project in Colorado where an ad valorem tax on both city and rural property helps pay construction costs.

Financial Assistance to Settlers?

Under the well-organized and widely applied practice of charging what the traffic will bear, it is proposed under problem 13 to charge the better class 1 lands more and the poorest class 3 irrigable land less per acre than the average per-acre construction cost allocated to the irrigation districts. The committee on problem 13 will undertake to recommend an equitable distribution.

Relieving financial burdens on settlers by means of all the devices previously referred to may still leave worthy and able settlers inadequately financed, and the committee on problem 14 is to explore possibilities of providing financial assistance in such cases.

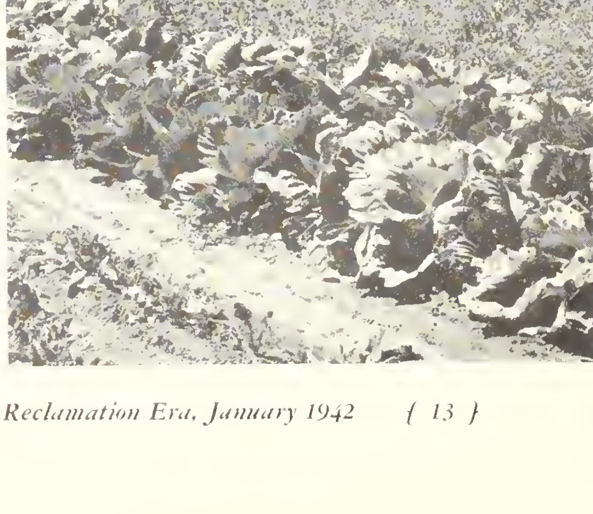
For the purpose of protecting the Government's investment, as well as of developing permanent homes on the land (it is believed to be wise, if not necessary, to provide for some Government control over the use of land until construction charges are paid. The committee on problem 3 seeks to find means by which the adoption of good farm practices can be enforced; and the committee on problem 5 has devised plans that will encourage the economical and noninjurious use of water.

Another group of problems on land control has to do with making land available to settlers without working hardships on preceding owners. Holders of large areas, particularly operators of large wheat farms, cannot afford to assume the obligation and expense of selling their holdings in small parcels and destroying their usefulness before the sales are complete. It is hoped that methods and agencies can be established for purchasing large land holdings, and subdividing and reselling them to settlers on the project. The laying out of farm boundaries to suit the topography, the control of town and community locations and of roadside nuisances, and many other matters make the centralized control of land to be settled very important. Problem 15 deals with means of securing control of unsettled land privately owned, and problem 16 deals with particular questions with respect to the control of State, county, and corporation holdings, when land is about to receive water, or earlier. Guided by the findings of the committee on problem 17, the Government will control the rates at which land is brought into production, provided Congress makes the necessary appropriations.

Among community problems receiving consideration are electric services (23), out-of-door recreational facilities throughout the project (25), and on the storage reservoir (26), community centers such as schools, churches, community halls, market centers, athletic fields, etc., (27), and governmental units suited to the heavy requirements of funds for schools, roads, etc., and the low taxable value of property in the period of development (28).

Four committees have already submitted final reports, 10 have made preliminary reports, and several others have prepared preliminary drafts of their reports. The benefits of the investigations will appear in legislation, in the repayment contracts between the Government and the three irrigation districts in the project area, in the management of the irrigation districts, in information to be made available to settlers for their guidance in farm development and operation, and in programs for cooperative action by the settlers.

Growing diversified crops in the Soap Lake area of Columbia Basin



Vallecito Dam Completed

San Juan Basin Celebrates

By **M. E. TRENAM**
Associate Engineer

IN SPITE of rain which fell throughout the day, hundreds of people of the San Juan Basin joined with representatives of the Government and of the water users in celebrating the completion of Vallecito Dam at a dedication ceremony held Sunday, September 14, 1941.

The program began at noon with a free barbecued beef dinner, and was featured by addresses by Chief Engineer S. O. Harper, of the Bureau of Reclamation; United States Senators Alva Adams and Edwin C. Johnson; Hon. Ralph L. Carr, Governor of Colorado; and District Judge J. B. O'Rourke. Judge O'Rourke was introduced by A. L. Wathen, Director of Irrigation, Office of Indian Affairs. There were many other prominent citizens and officials of the Government present, and local newspapers called it "the greatest galaxy of notables ever to appear in the San Juan Basin."

All of the speakers paid tribute to the late Edward T. Taylor, Member of Congress, for his untiring efforts in behalf of western reclamation, and particularly for his part in securing approval of construction of Vallecito Dam. District Judge O'Rourke, dedicated a bronze plaque to Representative Taylor which bears the simple inscription "In appreciation of the untiring service of Edward T. Taylor, M. C., in the cause of western reclamation." The plaque, which was sponsored by the Durango Chamber of Commerce, is mounted on a large and colorful conglomerate boulder situated on the crest of the dam at the right abutment. Senator Adams stated that the dam constituted the real memorial to Representative Taylor, "a man who gave his life to the betterment of the people among whom he lived."

Mr. Harper described the dam as "a milestone in a new era of Colorado water development," and expressed appreciation for the fine spirit of cooperation now existing between State and Federal authorities in the development of water resources of the West.

The plan to hold the celebration out of doors in an area adjacent to the dam, where a speaker's stand and bleacher seats for 1,000 people had been erected, was abandoned because of heavy rains on Saturday night and Sunday, and hasty preparations were made to serve dinner in the mess hall of CCC Camp BR–81, located about one-quarter mile downstream from the dam. The camp mess hall seats only 200 people, but a public-address system was installed which made it possible for a large part of the crowd to sit in their cars and hear the program. A hot pit-barbecued beef dinner was served by CCC enrollees to an estimated 1,000 persons. The efficient manner in which the large crowd was handled by CCC personnel with a minimum of confusion contributed a great deal to the success of the program. The Durango High School band furnished music throughout the dinner hour and between speeches.

Although the skies were still threatening and the roads were very muddy, at the conclusion of the program a large number of persons inspected the completed dam and witnessed the unveiling of the plaque dedicated to the late Congressman Edward T. Taylor.

The new irrigation reservoir has already demonstrated its byproduct value as a flood-control project by impounding flood waters this spring which would have caused considerable damage on the project. Although the dam was not completed early enough to store water to full capacity this year, 65,000 acre-feet have been impounded.

The reservoir will provide a supplementary water supply for 36,400 acres of land now under irrigation and also make possible the development of an additional 30,600 acres of irrigable land, a total of 67,000 acres. The lands to be served are situated in La Plata and Archuleta Counties and extend along the Pine River Valley from the dam to the southern border of Colorado. The elevation of the project varies from 6,300 to 7,000 feet above sea level and the length of the growing season is about 5 months.

The new dam is of the earth-fill type consisting of a moistened and rolled embankment of clay, sand, and gravel, protected on the upstream slope with a 3-foot layer of quarried rock riprap, and on the downstream slope with a heavy cobble and rock fill. The crest length of the dam, exclusive of the spillway, is 4,000 feet; the maximum height is 150 feet; and the maximum base thickness is approximately 900 feet. The total volume of the embankment, including riprap and cobble fill, is 3,700,000 cubic yards.

A reinforced concrete outlet conduit, constructed in open-cut near the right abutment, conveys water through the dam. The conduit is 610 feet long, has a capacity of 3,100 second-feet, and its discharge is controlled by two 5- by 5-foot hydraulically operated slide gates. The outlet conduit discharges into the emergency spillway concrete-lined open channel, which is 2,330 feet long and is located at the right abutment. The spillway has a capacity of 30,000 second-feet, controlled by three automatically operated radial gates, each 37 feet long and 19 feet high.

The reservoir created by the dam will extend about 3 miles up the Pine River Valley, and about 6 miles up the valley of Vallecito Creek, a tributary of the Pine River. Both rivers originate high in the San Juan Mountains near the Continental Divide. At its maximum storage elevation of 7,665 feet above sea level, the surface area of the lake is 2,723 acres, and at the minimum elevation (7,582.5) to which the reservoir can be lowered, it contains 4,300 acre-feet of dead storage covering an area of 380 acres.

The shore line of the lake and the surrounding mountains are heavily timbered with ponderosa pine, spruce, fir, and quaking aspen, making an ideal recreational area. The lake and streams are well stocked with rainbow and brook trout and the region is already a popular playground affording boating, fishing, and hiking, as well as magnificent scenery.

Of the total irrigable area within the Pine River Irrigation District, 6,000 acres are now under irrigation, of which approximately 18,000 acres are owned by the Southern Ute Indians.

The Indian-owned lands are served by canals constructed and maintained by the Indian Irrigation Service. The canal systems which now furnish water to the non-Indian lands are owned and maintained by various canal companies, the control and management of which is vested in the landowners on the project and operated as a community system. All of the existing canals divert directly from the Pine River or its tributaries within the project area, and, as no storage was provided before the construction of Vallecito Dam, there has always been a serious shortage of water during the late summer months.

The project was authorized by Congress in the Interior Department Appropriation Act of 1937, and was approved by the President on June 17, 1937. Actual construction by the contractor began on May 14, 1938. The total cost of the project is estimated at $3,300,000, of which about one-half is reimbursable, the remainder being charged to flood control.

The Pine River Irrigation District has entered into a contract with the United States to pay the reimbursable portion of the construction cost in 38 graduated annual installments. The Office of Indian Affairs is paying one-sixth of the reimbursable costs for their share of the project.

Vallecito Dam

POWER, byproduct of irrigation in many western localities, means strength for our armed forces in this war. The Federal Power Commission estimates that $2\frac{3}{4}$ kilowatt-hours of electrical energy will be required for every dollar spent in the war effort. Boulder, Grand Coulee, Shasta, and other great conservation structures of the Bureau of Reclamation take on a new significance as the terrible urgency of the need for aluminum, for planes, and for ships becomes clear. Scenes like that above are made possible in the great factories of the West because power is available in a never-ending surge from the great dams, which, through irrigation, will serve, after victory, vital peace-time needs

RECLAMATION from page 7

plans on the tantalizing wet years. Instead we must found a farm economy based on the dry years.

I welcome the rains of this year and revel in them. But they must not erase the memories of the drought of the thirties. If they do, then the time will come when, in retrospect, it will be this year of plentiful rain, and not the years of drought yet to come, which will be most bitterly resented.

The irrigation leaders of the West must take a firm stand for the maintenance of established agricultural areas and the sound growth of irrigation in the West through the provision of adequate water supplies. They must seek these ends by means of conservation of soil and moisture, provisions for permanent settlement on newly irrigated land, and action looking toward the anchoring of farmers in their present locations through adjustments in land use. The irrigationists must go forward by providing a free field for power in which to serve broadly the western people and to assist in irrigation development. They must accomplish it through protection of the integrity of the repayment principle, and through adequate preparedness now for the post-war adjustment later.

We stand ready, the Bureau of Reclamation and the West, together to do all, or such part as may be required, of the emergency job now before us. We will do it, moreover, without curtailing the utility of western streams for irrigation, which is and must remain their major rôle.

I have pointed the way by which a solid foundation can be laid for the West of the future. I foresee days requiring sacrifices, months of disappointments. These times cry for a high order of statesmanship.

We must review and revise our programs week by week and month by month. Now as never before we must project our plans far beyond our present horizons.

If we do, this year will be among the most significant in the history of Federal Reclamation.

HONOR ROLL

Continued from December 1941 Issue

DENVER OFFICE

Young, Robert J., Jr., junior engineer, secondary investigations, Green River, Wyo. Second lieutenant, Inf. Res., U. S. Army. Called to active duty September 27, 1941.

CENTRAL VALLEY PROJECT, CALIFORNIA

Berry, Myron S., assistant engineer. First lieutenant, Corps of Engineers Reserve, Quartermaster Corps, Santa Maria, Calif. Called to active duty October 23, 1941.

Eager, Herbert E., assistant engineer. Ensign, Section Base, Patrol Force, U. S. Naval Reserves, San Francisco, Calif. Called to active duty October 27, 1941.

Enger, Walter M., assistant engineer. Lieutenant, junior grade, Civil Engineering Corps V(S), U. S. Navy. Called to active duty December 9, 1941.

Folsom, Oliver H., assistant engineer. Second lieutenant, Quartermaster Corps, U. S. Army. Called to active duty October 17, 1941.

Lindemann, Jack B., assistant engineer. First lieutenant, U. S. Coast Artillery, U. S. Army. Called to active duty October 11, 1941.

Monroe, Wesley D., assistant engineering aide. Commissioned radioman 2d Class, U. S. Naval Reserves, Oakland, Calif. Called to active duty September 22, 1941.

Needham, Fred E., assistant engineer. First lieutenant, Inf. Res., U. S. Army. Called to active duty September 24, 1941.

Shukle, Richard J., assistant engineer. Ensign, Civil Engineering Corps, U. S. Naval Reserves. Called to active duty September 26, 1941.

COLORADO-BIG THOMPSON PROJECT, COLORADO

Williams, Walter T., rodman. Second lieutenant, FA Res., 436 Georgia, Vallejo, Calif. Called to active duty September 2, 1941.

COLUMBIA BASIN PROJECT, WASHINGTON

Bockemohle, Gordon G., assistant engineer. Second lieutenant, Engineer-Reserve, U. S. Army. Called to active duty October 3, 1941.

Chittick, Vess A., laborer. Called to active duty February 10, 1941.

Fits, Harvey E., rodman. Private, U. S. Army. First Replacement Battery, 114th Field Artillery, Fort Lewis, Wash. Inducted into Army May 17, 1941.

Grant, George A., inspector. First lieutenant, U. S. Army. Called to active duty August 8, 1941.

Knight, John A., electrician's helper. U. S. Naval Reserve. Called to active duty May 1, 1941.

Long, Robert E., levelman. Private, U. S. Army. Battery A, 55th FA, Training Battalion, Camp Roberts, Calif. Inducted March 20, 1941.

Magin, David R., rodman. U. S. Army. Company B, 18th Engineers, Vancouver Barracks, Wash. Inducted April 11, 1941.

Matson, George A., engineering draftsman. U. S. Army. First lieutenant, 29th Engineer Battalion. Called to active duty June 8, 1941.

Miles, Robert E., clerk. U. S. Army, 295 Q. M. G., Moffett Field, Calif. Inducted April 3, 1941.

Nansen, Edward N., laborer. Inducted into U. S. Army March 4, 1941.

Neff, George Eldon, rodman. Company A, 28th Engineer Training Battalion, Fort Leonard Wood, Mo. Inducted into U. S. Army August 5, 1941.

Peyser, Meyer E., engineering aide. Private, 18th Engineers, Co. A, King City, Calif. Inducted into U. S. Army April 8, 1941.

Pylman, Lowell R., watchman. U. S. Army, 163d Inf., King City, Calif. Inducted April 22, 1941.

Looking upstream at Green Mountain Dam, power plant left foreground, spillway channel on right

Green Mountain Dam Excavation Nears End

By VAUD E. LARSON

Field Engineer

EXCEPT for about 140,000 cubic yards at the abutments, excavation work for Green Mountain Dam on the Colorado-Big Thompson Reclamation project in Colorado is complete.

About 1,242,000 cubic yards of earth and 128,000 cubic yards of rock have been removed from stripping for the dam, open-cut excavations for the outlet works, powerhouse, and spillway channel.

Green Mountain Dam is an earth and rock-fill structure which will impound a water supply for irrigation farmers on the western slope of the Rocky Mountains, replacing that diverted to the eastern slope and project lands.

The dam is 274 feet high and is built in zones. The approximate volumes of the different zones in the dam are as follows: Impervious 2,360,000 cubic yards, upstream and semipervious 530,000 cubic yards, cobble and rock fill 1,360,000 cubic yards, and riprap 50,000 cubic yards.

The borrow area and a large part of the required common excavation for the dam and appurtenant structures are composed of glacial till in which the moisture content varies from a minimum of 4 percent up. In general it is reasonably uniform. The total volume of glacial boulders over 3 inches in size averages 18 percent.

Construction progress on the dam at first was greatly retarded because of difficulty in working out a satisfactory and economical processing plant for separating the oversize from the impervious and semipervious material, as required by the specifications for construction of Green Mountain Dam. They provided that the rolled-fill portion of the embankment shall be constructed of materials which will pass through a grizzly having 3-inch openings and that the rock or cobbles in the rock-fill section shall be not more than 1 cubic yard in volume.

Placement began May 20, 1940, and was suspended November 3 on account of bad weather. Only 376,000 cubic yards of earth fill in embankment and 191,000 cubic yards of cobble and rock fill were placed. The work was resumed April 30, 1941.

2,300,000 Cubic Yards of Fill Placed in Dam

Over 2,300,000 cubic yards of earth and cobble and rock fill have been placed to date on Green Mountain Dam. The fill has now reached within about 150 feet of estimated crest height.

The contractor's original plan of separating embankment material in order to "zone" the dam was a self-propelled processing plant. The excavator, a 5-cubic yard 120–B Bucyrus-Erie shovel fed the screens direct from the point of excavation. The excavator and the screening plant had to move in nearly parallel positions within narrow limits of divergence both horizontally and vertically. The capacity of the plant exceeded the output of the 5-cubic-yard shovel, but it was physically impossible to use more than one shovel.

This method of separating the material was found very unsatisfactory. The contractor decided early in the summer of 1940 to construct a stationary plant with the large movable separating machine.

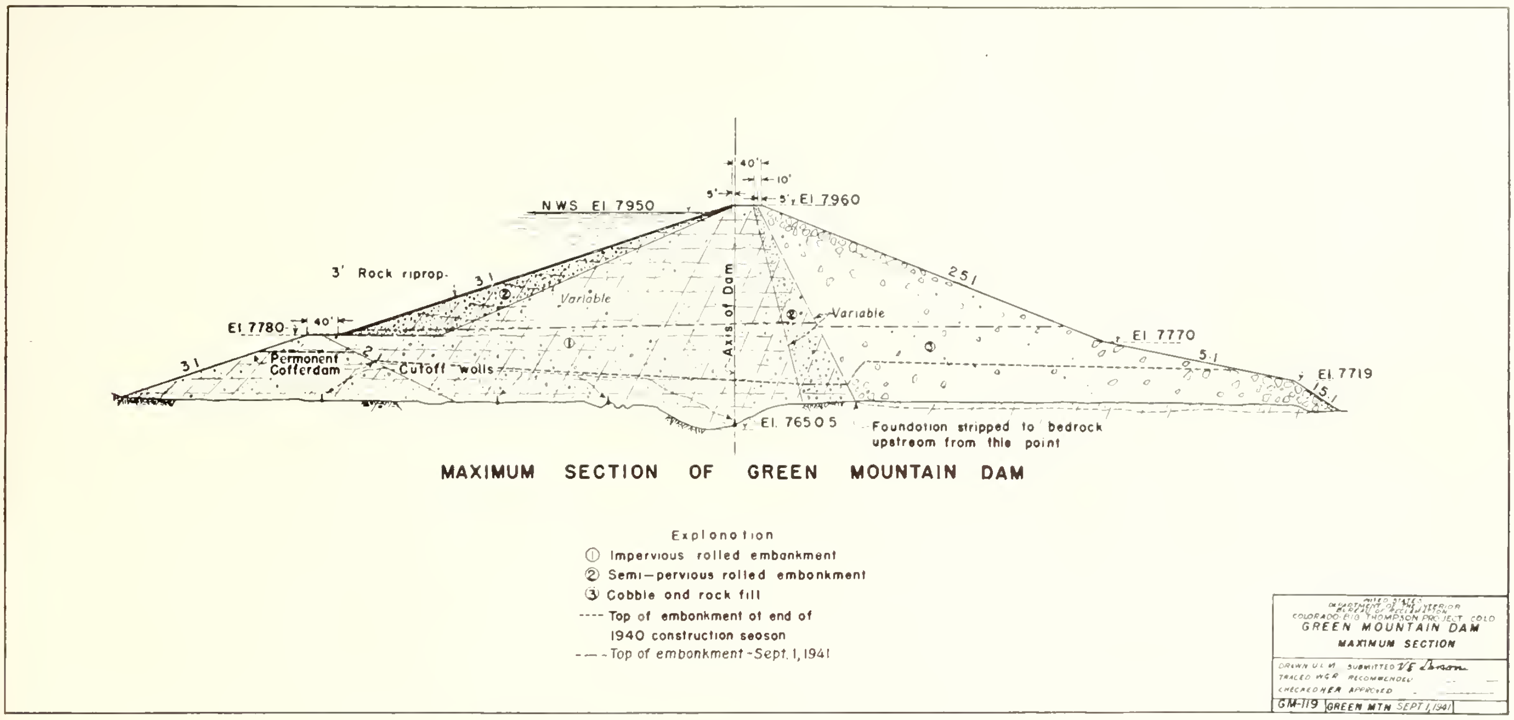
A design was worked out which was undoubtedly the most elaborate ever used for processing of material for earth dams. A semicircular timber trestle was erected with access to loaded trucks from either end. Two hydraulically operated steel gates traveling horizontally on rails formed the roadway over the chute in the center of the trestle. After a truck had passed over, the gates were opened and the material end-dumped from the truck into a chute.

Boulders Strike Huge Chains

The upper 50 feet of the chute was constructed as a scalping grizzly, and the bars initially installed were 130-pound rails spaced at 9-inch centers. Boulders which did not fall through the grizzly bars crashed down a metal-lined chute until they hit nine large endless chains, each weighing 3,800 pounds. The chains hung from a revolving shaft operated by an electric motor. As the chains revolved, the rock was fed into trucks and conveyed to the rock fill.

The material passing through the grizzly bars at the top of the plant dropped into a bin of 150-cubic-yard capacity with two outlet chutes, each equipped with a chain feeder consisting of eight endless chains weighing 2,300 pounds each. The material was fed to the shaker screens of the movable plant, which now had been made a part of the stationary separating plant. Rock passing over these screens was transported by a structural-steel conveyor and dumped into the rock chute above.

Placed in operation on September 4, 1940, the plant required many changes, adjustments,



Maximum section of Green Mountain Dam

and repairs. At the close of the season it was decided to dismantle it and build one somewhat on the same principle but with modifications at a higher elevation.

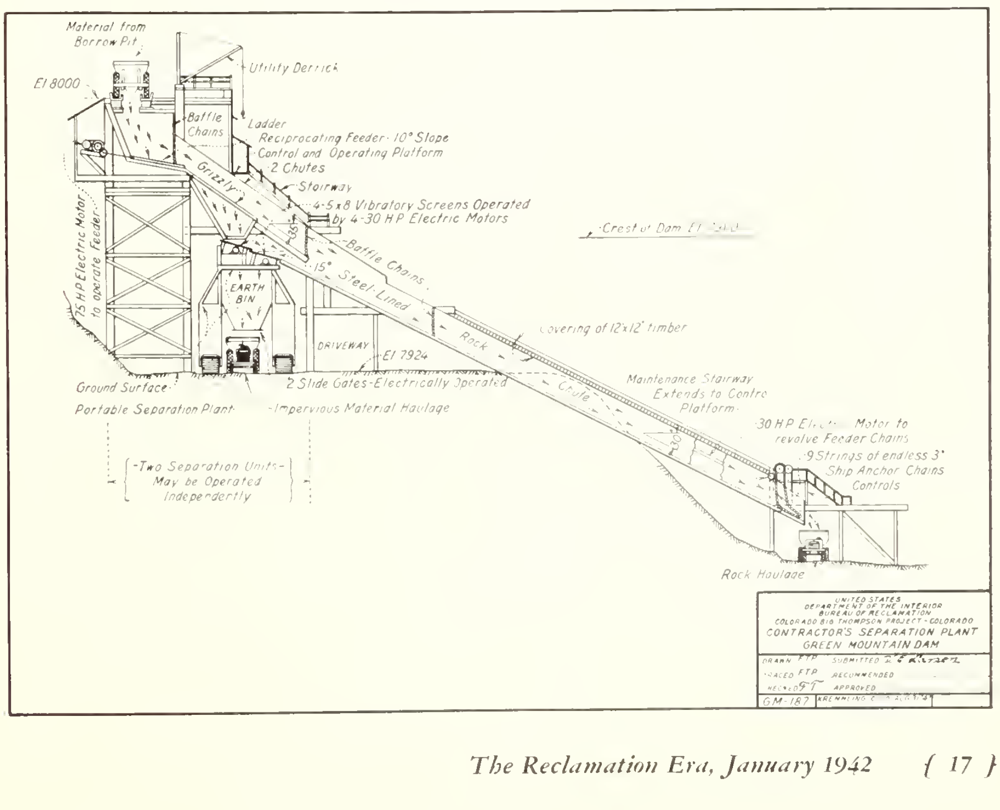
The new plant, now in operation, works as follows: The material to be separated is transported to the plant in bottom-dump Euclid trucks which slow down as they dump into two storage bins, each equipped with reciprocating feeders. The feeders, which have an 8-inch stroke, feed the material over specially made grizzly bars spaced 7 inches at the top and increasing to 10¼ inches at the lower end. The coarse rock passes on down a metal-lined chute and the finer material is separated by the shaker screens having 3-inch openings. The rock retained on these screens is combined with the larger rocks in the same chute. The portion passing through the shaker screens drops into a bin from which it is loaded into trucks.

The new plant improved the processing and bettered the production. Reciprocating feeders which feed the material quite steadily to the grizzly bars, and two feeders, two sets of grizzly bars, and two sets of shaker screens, so that either side may be operated independently of the other, increased efficiency. However, the plant has a large number of moving parts which wear rapidly and difficulty is frequently experienced with rock lodging in the grizzly bars and shaker screens. The plant still causes delays in earth-fill operations.

During the 1940 season material for the embankment was transported from the point of excavation to the separation plant by end-dump trucks having a nominal capacity of 25 cubic yards. Similar trucks were used to transport the rock from the plant to the rock fill. Material passing the 3-inch screen was conveyed to the impervious section of the dam by bottom-dump Euclid units of 18-cubic-yard capacity. Additional bottom-dump Euclid units were purchased for the 1941 season to replace the Mack trucks in transporting the material from the borrow pit to the separation plant.

The material is compacted by tamping rollers to a thickness of approximately 6 inches per layer. In locations inaccessible to the rollers, compaction is attained by hand-operated air hammers with tamping feet. The average dry-weight density of placed material passing a one-fourth-inch screen is 133.3 pounds, or 1.2 pounds higher than laboratory compaction at the same moisture content. The average wet density of earth and rock

Contractor's separation plant, Green Mountain Dam



(3-inch maximum) in the fill is 130.6 pounds, with a maximum of 137 pounds. The material is placed with an average moisture content of 0.6 percent below optimum moisture content, which varies from 7.5 to 9 percent for the different areas in the borrow pit where the impervious material is obtained.

Concrete work on Green Mountain Dam consists of construction of a hoisthouse, trash-rack structure, embankment cut-off walls, parapet and curb walls, spillway-gate structure and lined channel, a powerhouse, and linings for the inlet shaft, hoist shaft, and diversion tunnel. All first-stage concrete has been placed in the powerhouse except the pedestals for erection of valves and turbines.

The concrete is mixed at a central mixing plant and conveyed by dump trucks to a hopper, where it is pumped to the point of placing or transported by trucks in 2-cubic-yard bottom-dump buckets which are lifted by a crane to the point of placing.

Consolidation of the concrete is attained by means of internal vibration. A clear-pigmented compound "Konkure" was used to cure the concrete cut-off walls in the dam. Curing of other concrete is accomplished with water supplied by perforated rubber hose or by hand sprinkling.

An absorptive form lining is being used on exposed surfaces of the spillway walls and all exterior surfaces of the powerhouse. This lining has proved very effective in eliminating the air and water voids present in concrete formed by conventional methods. Since the fresh concrete tends to stick to the absorptive lining, considerably more than the customary amount of vibration is necessary to prevent rock pockets and honeycomb. Practically no difficulty has been experienced in removing the absorptive lining after the concrete has hardened. The surface is superior in density and durability.

TUCUMCARI from page 11

through a 2-inch pipe line and was kept at 80 pounds pressure at the face with a Gardner-Denver air-booster pump located near the heading.

One-inch hexagonal drill steel with detachable bits was used. In all the tunnels after each drill-out the steel was taken to the shop, where it was examined for plugged steel, and the worn detachable bits were replaced.

The number of holes drilled per round and the length of the round depended on the ground, but the usual round consisted of 40 holes, loaded with 150 pounds of 45 percent powder, pulling 10 feet of ground which measured 60 cubic yards of muck. In each of the tunnels some bad ground has been encountered which has required the use of crown bars, and near the outlet of tunnel No. 2 the tunnel was driven through what apparently was an old stream bed. For 275 feet the sand came in from the sides, crown, and face, and it was necessary to place the tunnel steel supports 12 inches apart and drive spiling ahead, as well as breast-board the face.

The mucking was done with Type 60 Conway muckers; 4-cubic-yard side-dump cars pulled by 8-ton battery tunnel locomotives being used to transport the muck from the tunnels. Fifty-six-pound rails were used in the tunnel, and the track was kept in good shape, permitting fast-time runs out of the long tunnels, which were all bored from only one end. A passing track, cherry picker, and a stub spur were all tried and used in mucking-out the passing track proving the most satisfactory in switching the cars at the heading.

Timbering was required in all the tunnels with the exception of two short sections in tunnel No. 1 where sufficiently hard sandstone was encountered and the timbering eliminated. Timbering was carried on by the heading crew immediately after mucking out. Five-inch structural-steel supports with native lumber for lagging, bracing, and foot blocks constituted the timbering material.

Placement of the concrete lining follows immediately the completion of excavation. Aggregate for the concrete was prepared under a separate contract, and was processed at aggregate area No. 1, located on the South Canadian River 3 miles northeast of Conchas Dam, and aggregate area No. 2, also located on the South Canadian River, and 2 miles northeast of the outlet of tunnel No. 3. It is estimated that approximately 100,000 tons of aggregate and 75,000 barrels of cement will have been required in the tunnel lining and appurtenant structures. The completion date is January 21, 1942, and all of the time until that date will probably be required to complete the job.

The engineering is under the general supervision of the Tucumcari office, H. W. Mutch, resident engineer. The Conchas division is under the direction of H. E. Robinson, associate engineer, with C. H. Rader, assistant engineer, in charge of tunnels. Engineers have been on the job continuously giving line and grade and checking the placement of lagging. An instrumentman only was required on "swing" and "graveyard" shifts, while a four-man party was used on day shifts, setting permanent line and grade points in addition to the heading points.

Permanent line and grade points were carried through the tunnels by means of brass caps set in concrete blocks located on center line and below invert grade. Working points for daily use were carried in the crown, and consisted of tubular electric lamps. These proved very satisfactory, especially when the tunnel was smoky or foggy.

Two More Boulder Books

TWO MORE engineering reports have been published in book form on the Boulder Canyon Reclamation project of Arizona-Nevada-California, water and power bulwark of the Southwest.

The two printed reports, Bulletins 1 and 2 of Part IV, Boulder Canyon Project Final Reports, bring to 11 the printed studies published to date on the great multiple-purpose project.

The latest reports deal with the design and construction of Boulder Dam, highest dam in the world and one of the most magnificent engineering accomplishments of the age. Each volume sells for $1.50 paper-covered or $2 cloth-bound.

Preceding reports of the series have dealt with technical, hydraulic, and concrete investigations. These include the following:

Trial Load Method of Analyzing Arch Dams. Paper $1.50, cloth $2.

Slab Analogy Experiments. Paper $1, cloth $1.50.

Model Tests of Boulder Dam. Paper $1.50, cloth $2.

Stress Studies for Boulder Dam. Paper $1.50, cloth $2.

Penstock Analysis and Stiffener Design. Paper $1, cloth $1.50.

Model Tests of Arch and Cantilever Elements. Paper $1, cloth $1.50.

Model Studies of Spillways. Paper $1, cloth $1.50.

Model Studies of Penstocks and Outlet Works. Paper $1, cloth $1.50.

Thermal Properties of Concrete. Paper $1, cloth $1.50.

The new bulletins are the first to undertake a description of the dam itself and its construction.

The Boulder Canyon project is characterized so largely by the extraordinary that the reports on aspects of construction are not only highly valuable to the engineering profession and the construction industry but are of intense interest to the engineer and layman.

Bulletin 1, part IV, of the series of studies entitled "General Features," reviews the background of conditions leading to the creation of the project and traces the developments up to the beginning of construction operations. It follows with a general descriptive account of the design and construction of the dam and other major engineering works on the project. The book has 301 pages, 164 illustrations, diagrams, and charts.

Bulletin 2 of part IV, entitled "Boulder Dam," deals primarily with the actual physical characteristics and dimensions of Boulder Dam. It sets out the technique used in preparing the foundation and abutments and the methods of placing the concrete, which totaled 3,250,000 cubic yards, or about 6½ million tons. It has 253 pages and 130 illustrations, charts, and diagrams.

Buffalo Rapids No. 2 Progressing

By JOSEPH W. GRIMES

Office Engineer

CONSTRUCTION of the second division of the Buffalo Rapids water conservation and utilization project, which started in September 1940 and is largely dependent upon the availability of WPA labor, is progressing.

Work on the Montana project is carried on throughout the year despite the low temperatures which require heating all aggregates and structures during and after concrete placement in the winter.

Excavation is very difficult in frozen ground and great care must be exercised to provide watertight banks for the canals. Working conditions for the men are difficult. These conditions are reflected in the costs which are somewhat higher than those for similar jobs constructed under contracts.

The Shirley pumping plant building and the Shirley main canal are complete. The lateral excavation is nearly done and construction of irrigation structures for the lateral system is well advanced.

Excavation for the Terry Unit pumping plant was completed in June 1941, and that for the Terry main canal is also practically complete.

The second division of the Buffalo Rapids project extends 32 miles on the southeasterly bank of the Yellowstone River beginning 18 miles downstream from Miles City, Mont. The irrigable land has a maximum width of 2½ miles. The area is on two sloping benches, each ending in an abrupt slope to the river.

The climate is typical of the northern Great Plains region (a maximum of −65 to 117 over a 60-year period), with short winter days and exceptionally long days during the growing season. Precipitation averages about 15 inches, most occurring in the spring. The promise of the luxuriant green grasses of spring is rescinded by the brown burned-out growths of midsummer.

Dry-land Farming Abandoned

The past 10 drought years have seen almost complete abandonment of dry-land farming in the area. Relief and rehabilitation of these stranded farmers is the purpose of the project.

The total allotment for the second division approved by the President on May 15, 1940 amounted to $1,840,000. Of this, $740,000 was allotted from the Water Conservation and Utility Projects item of the Department of the Interior Appropriation Act of 1940. This was made reimbursable in accordance with the act over a maximum period of 40 years by repayment from the water users. These reimbursable funds are allotted to the Bureau of Reclamation, but of this amount the Farm Security Administration is to expend $225,000 for farm development. The remainder of the reimbursable funds, $515,000, is for use for construction of the irrigation works. On June 6, 1941, the President approved a further allocation of $120,000 for the acquisition of agricultural lands within the division boundaries.

$1,100,000 in WPA Funds

The remaining $1,100,000 of the total appropriation is nonreimbursable WPA funds. Of this amount the Farm Security Administration was allotted $225,000, and the Bureau of Reclamation $875,000, for labor. All labor used on the job is certified from the Montana relief rolls by WPA.

Two other agencies are cooperating with the work. The National Resources Planning Board assists in the planning and coordinating field between the Federal agencies and soon the Civilian Conservation Corps will have a camp at Terry, Mont., and enrollee labor will become available.

The irrigable area totals 11,600 acres in three units. The Shirley unit comprised of 5,300 irrigable acres is served from the flow of the Yellowstone River by a pumping plant. The main canal is 13 miles in length with 22 drainage culverts, 2 wasteways, and 8 siphons. The lateral system totals 14 miles in length with a capacity range of 5 to 46 cubic feet per second.

The Terry unit contains 2,800 acres of irrigable land encircling the town of Terry, Mont. The main canal, which receives water pumped from the Yellowstone River, is 7 miles in length and has six drainage culverts, a wasteway, and three siphons. The lateral system totals 12 miles in length and has capacities of 5 to 29 second-feet.

On the Fallon unit two pumping plants are required to serve the 3,530 acres of irrigable land which surrounds the town of Fallon. A relift plant will be located about 4 miles downstream on the main canal.

The Farm Security Administration has optioned about 75 percent of the irrigable acreage of the second division. Ultimately this area will be owned by the Federal Government, but for construction purposes, blanket donation easements were secured for the various irrigation features. In a few cases right-of-way was provided by the patent law of 1890. Some tracts were public land. Special contracts were necessary with the operating divisions of the railroad companies for track crossings and lateral alinement. Right-of-way plats will be drawn when final locations of canals and laterals are complete.

Articles for Reclamationists

ALL-AMERICAN CANAL. Placing the All-American Canal in operation, by L. J. Foster, Construction Engineer, U. S. Bureau of Reclamation, Yuma, Ariz. Paper delivered before Irrigation Division of American Society of Civil Engineers at meeting in July 1941 at San Diego, Calif., Civil Engineering, October 1941, pp. 580–583. Description of construction methods used to eliminate all possible waste of water en route in sand hills adjoining All-American Canal.

CENTRAL VALLEY PROJECT CALIFORNIA FRIANT DAM, PART I. Article in Compressed Air Magazine, October 1941, pp. 6562–6567 illustrated. Gives description of dam, the methods used in its construction, the reasons for building, the lack of balance between water distribution and irrigable soil in Central Valley, a 500- by 50-mile area involving the Sacramento and San Joaquin Rivers. By Henry W. Young.

CONSTRUCTION FEATURES OF SHASTA PROJECT. PART II. Conveying aggregate, mixing and placing concrete. By Ralph Lowry, Construction Engineer, Civil Engineering, July 1941–, pp. 409–12.

PROGRESS IN CONSTRUCTION PRACTICE. By Hal W. Hunt, Engineering News Record, February 13, 1941, pp. 105–7. (Includes Shasta, Friant, Absorptive Form Lining.)

RAILROAD RELOCATION AND CONSTRUCTION AROUND SHASTA DAM. PART I. By J. A. Given, Civil Engineer, August 1941, pp. 461–4. The reconnaissance, preliminary, and final surveys in connection with relocation of Southern Pacific Railroad.

SILT TAKES HEAVY STORAGE TOLL. Article by Carl B. Brown, Head, Res. Sec., Sedimentation Division, Soil Conservation Service, Department of Agriculture, Washington, D. C., in which he states: "Storage capacity lost by silting will destroy, in fifty years, one-third of Nation's water supply reservoirs."

TECHNICAL MEMORANDA. No. 617. Grouting Contraction Joints, Seminoe Dam, Kendrick Project, Wyoming, by A. W. Simonds, 1941 ($1.50). Write Chief Engineer, Bureau of Reclamation, Denver, Colo., for information on technical memoranda.

TIME REQUIRED TO SATURATE AN EARTH DAM. By K. P. Karpoff, Civil Engineering, April 1941, pp. 238–240.

TRENDS IN POWER-PLANT SPACE ECONOMY. By H. G. Gerdes, Civil Engineering, April 1941, pp. 214–17.

TURBULENCE IN OPEN CHANNEL FLOW. By A. A. Kalinske and J. M. Robertson. Laboratory experiments reveal new information on sediment transportation in streams. Engineering News-Record, April 10, 1941, pp. 53–55.

WATERSHED AND HYDROLOGIC STUDIES ON THE GREAT PLAINS. Allis and Kelly, Agricultural Engineering, June 1941, pp. 215–17. Soil Conservation Service experiments to determine the "effect of land use upon run-off and erosion."

WHAT FARM ELECTRIFICATION NEEDS. B. D. Moses, Agricultural Engineering, May 1941, pp. 179–180, and 184.

WHAT PRIORITIES MEAN TO CONSTRUCTION. Engineering News-Record, June 5, 1941, pp. 62–63. By Robert Colborn.

YUMA PROJECT, ARIZONA. Influence of Colorado River silt on some properties of Yuma Mesa sandy soil, by W. T. McGeorge. Published by the University of Arizona, Tucson, Arizona (18 page booklet).

NEWS OF THE MONTH

Defense Plant for Boulder

BASIC MAGNESIUM, INC., a new magnesium plant under construction near Boulder City, will require a billion and a half kilowatt-hours of electric energy annually, taking all the available unused Metropolitan Water District allotment of Boulder Dam's output plus a large part of the Davis Dam plant soon to be under construction at the Bullshead site 150 miles below Boulder. Ultimately, with full operation, the plant is expected to require energy from the Bridge Canyon plant if and when a dam and hydro plant are constructed at this site on the Colorado River just above the flood peak waters of Lake Mead. Parker Dam's power plant which goes into operation this year cannot supply Basic Magnesium with energy because more applications for Parker power were received than could be supplied, before the magnesium plant was conceived. The satisfaction of normal and emergency electric energy needs in the Southwest today hinges largely on Reclamation construction.

LIVESTOCK PASTURING was active on the Klamath (Oreg.-Calif.) project this winter. About 6,500 steers, 1,800 beef cows and 23,000 sheep were fed.

BLACKED OUT at the beginning of Japanese hostilities, December 7, Boulder Dam is under heavy guard and no visitors are permitted to enter the dam or the power plant. Gates have been closed on the interstate highway crossing the dam which connects Kingman, Ariz., and Las Vegas, Nev. No cars are permitted except in convoy and under armed escort. Precautions have been taken by the Bureau at Grand Coulee and other Reclamation dams and power plants.

NEARLY 3,000 acres of peas may be planted on the Klamath (Oreg.-Calif.) Reclamation project this year. Returns from 350 acres of Austrian field peas on the project last year were good. Yield was a ton to the acre or better.

SUCCESS with experimental plantings of paprika peppers and sage on the Yakima project in Washington promises a commercial acreage of spice crops on the project next year. Cessation of spice imports from Europe and the demonstrated success of experimental plantings make spice cultivation on Reclamation projects appear profitable to irrigation farmers.

TWENTY of the 24 leases for farming the rich Tule Lake sump on the Klamath project in California have been extended for another year. The new leases cover about 8,700 acres. Four leases covering about 1,300 acres were not renewed; three are under water and the fourth falls within the area of wildlife refuge. The fertile soil of the sump is leased rather than homesteaded by the Bureau of Reclamation because of floods from melting mountain snows generally occurring each spring.

DEANE S. STUVER has been appointed Assistant General Supervisor of the Operation and Maintenance Division of the Bureau. Stuver has been construction engineer on the

Deschutes project in Oregon since February 1940.

The recent reorganization and expansion of operation and maintenance duties, with John S. Moore at the head of the division, left the assistancy in the division's new headquarters at Denver vacant. Stuver fills this position. A. R. Golzé continues in the Washington office as Assistant Supervisor of Operation and Maintenance work.

Stuver was first employed by the Bureau in 1910 on the Newlands project in Nevada. He was promoted from junior to assistant to associate engineer and in 1926 became project manager. In 1934 he was assigned to the Washington office, and for 3 years before his Deschutes assignment acted as assistant general supervisor of operation and maintenance.

AMERICA is eating more meat, reports the National Live Stock and Meat Board. Per capita consumption last year was 141.6 pounds, a gain of 8.7 pounds over 1939, and 14.3 pounds over 1938. Last year more than 123,000,000 head of cattle, hogs, and sheep provided a total of 18,712,000,000 pounds of meat. This was the greatest amount consumed in any year in the Nation's history and a gain of 1,289,000,000 pounds over the previous year. Half the Nation's forage for the livestock industry in the West is grown on irrigated farms—a valuable contribution to the country's food supply.

THE DIAMOND DRILL CREW at Wagon Wheel Gap reservoir site on the San Luis project in Colorado has been shifted to the more urgent exploration of the Bridge Canyon site in Arizona.

SUNNYSIDE water users of the Yakima Reclamation project in Washington have voted 759 to 512 against a proposed contract settling the disposition of irrigation water on the project. The Bureau of Reclamation has been striving for a settlement satisfactory to the Sunnyside Irrigation District, to take the matter out of litigation.

ACTING DIRECTOR Abe Fortas of the Power Division, Department of the Interior, has been made Director. The Power Division was created April 18, 1941, as a clearing house for the intricate questions arising from power development. The main job of the Power Division is the coordination of power policies and activities within the Department and with other agencies producing power. In the Department of the Interior under one centralized control are agencies producing the greatest volume of electric energy in the world. The most important agency is the Bureau of Reclamation.

ENGINEER George W. Howson has been assigned to the King River project studies in California.

ADDITIONAL APPOINTMENTS have been officially made to the reorganized Operations and Maintenance Division of the Bureau of Reclamation. Thomas W. Parry, District Conservation Section of the Division of Operation and Maintenance, was promoted to Field Supervisor. Jack W. Rodner, formerly with the Soil Conservation Service of the Department of Agriculture at Yakima, Wash., was named Soil and Moisture District Conservationist in charge of region IV, covering the Southwest.

SHASTA DAM, second highest concrete dam in the world now building on the Central Valley Reclamation project in California, will be 602 feet high, exceeding original height estimates by 42 feet. The beautiful curved gravity dam now rising astride the Sacramento River to impound water for irrigation, power, and other purposes was originally expected to reach 560 feet—barely to top Grand Coulee Dam's 550 feet and undershoot the 726 feet of Boulder Dam, highest in the world, by a good 166 feet. More intensive exploration and actual excavation of the site 12 miles north of Redding have revealed that solid bedrock will be deeper down in the ancient riverbed than preliminary examination anticipated. Shasta's 602 feet from foundation bedrock to crest will be the equivalent of more than a 50-story building. It will be nearly half as high as the Empire State Building in New York City. It will be 150 feet higher than San Francisco's tallest skyscraper. Concrete placement on the dam—running to 6,000,000 cubic yards or more than 12,000,000 tons— is rapidly approaching the half-way mark. The structure is expected to be finished in 1943. The first concrete was poured last year under a contract for the construction of the dam and power plant awarded in July 1938.

IN PROGRESS this winter are 135 Reclamation investigations of potential irrigation and power projects in 17 Western States, with 680 engineers and other Bureau employees assigned to this phase of Reclamation's work of building the West.

QUICKSILVER is being mined near the Humboldt project in Nevada—the Pershing Quicksilver Co. is operating a mine closed down for 11 years, located 20 miles northeast of Lovelock.

Boulder Plant to Top Million Kilowatts

ANOTHER GIANT GENERATOR will be added to bring to more than a million kilowatts the capacity of the Boulder Dam power plant, already the largest operating hydroelectric plant in the world. The new generator, N 7, similar to the six 82,500-kilowatt generators already operating in the Nevada wing and the three in the Arizona wing, will bring installed capacity to 1,034,800 kilowatts, including the 40,000-kilowatt generator in the Arizona wing and the two 4,800-kilowatt station generators.

Boulder Dam already is meeting critical power deficiencies in the heavily industrialized areas of southern California. Additional power will be needed for vital defense industries, particularly for the magnesium plant being constructed near Las Vegas, Nev., by the Defense Plant Corporation. This new generator will help meet the new needs.

Installation of A–2 and A–5 is being rushed, one for operation about the first of the year and the other for operation in July 1942, but even these will not be adequate to meet the demands of the present airplane, shipyard, and mineral processing plants in the California-Arizona-Nevada area. Present plant capacity is 787,300 kilowatts.

EXPANSION of wool production in the Belle Fourche (S. Dak.) Reclamation project area is indicated by construction at Belle Fourche of a new wool warehouse, larger than the Newell (S. Dak.) warehouse, the biggest wool storage house in the State. The new warehouse has a capacity of 3,500,000 pounds. Wool sales at Newell and Belle Fourche last year totaled 7,500,000 pounds.

A MEMBER of Bureau of Reclamation CCC Camp 42 on the Owyhee project received the opportunity for training which ultimately led to the station of flying officer in the Royal Air Force. Kenneth Hoover, "grease monkey" and later camp clerk, took a Civil Aeronautics ground school course at Ontario, Oreg., while at the camp which gave him his start. On his discharge from the camp he followed it up with employment at the Ontario airport, and then enlisted in Canada.

THESE PHOTOGRAPHS are not Indian pictographs or surrealistic paintings in a modern art exhibition but patterns of stresses revealed by the photoelastic method of stress analysis used in the designing offices at Denver for determining the best details to be used in modern irrigation structures. The pattern on the left shows the stresses around a gallery in a concrete gravity dam; on the right is a rocker support for the Pit River bridge superstructure. Tiny transparent models of proposed structures are tested and by a technical arrangement of mirrors and prisms, the shadows of the way in which structures carry their loads are thrown on a screen and photographed. From these photographs the points of weakness of the actual structures can be determined in advance and changes made so as to make them adequately strong with the least amount of material.

TURBINES, generators, transformers, and governors already have been ordered for the 75,000-kilowatt power plant at Keswick Dam on the Central Valley Reclamation project, California. Added to the 375,000 kilowatts at Shasta Dam, this plant will bring to 450,000 kilowatts the total installed capacity of power plants on the Central Valley project. Power from these plants is expected to be available late in 1943 or early in 1944 when the shortage will be most acute, according to present indications. Construction on Keswick Dam is well under way. The site is several miles below Shasta.

HIGHEST PRICE ever received in the United States for ram lambs is indicated on the Minidoka Reclamation project in Idaho, when project irrigation farmer T. S. Bell sold 8 Panama ram lambs at the Pocatello Fall sale at $100 a head.

POWER EQUIPMENT has been ordered for the power plant at Green Mountain Dam on the Colorado-Big Thompson project in Colorado, which was recently placed in the national defense category. The power machinery received a preference rating by the Office of Production Management. The power plant, under construction on the right bank of the Blue River in Green Mountain Canyon immediately downstream from Green Mountain Dam, will house two 10,800-kilowatt generators. This installed capacity will be capable of producing about 80,000,000 kilowatt-hours annually for defense industries and other uses in the area. The Green Mountain plant is the first of six power plants planned for the Colorado-Big Thompson project, which will have a combined capacity of 180,000 kilowatts for the production of nearly 900,000,000 kilowatt-hours annually.

Marketing Possibilities for Dairy Products

From the Columbia Basin Irrigation Project

By MARION CLAWSON, *Bureau of Agricultural Economics, United States Department of Agriculture*

THE MARKETS to which dairy products from the Columbia Basin can be sent, the prices that probably will be received in those markets, and the cost of getting dairy products from the farm to the consumer will affect the success with which the Columbia Basin Reclamation project can be settled and developed. Although water will not be available until 1944 or 1945, the Department of Agriculture and other agencies have been making a cooperative study of the situation.

Dairying will probably be the major type of farming in the Columbia Basin. The project is well suited to the growth of alfalfa, pasture, and other feed crops. The soils are medium to light in texture and generally lack organic matter. Feed crops and livestock will help overcome this deficiency in organic matter. Some of the sloping lands can be used for hay and pasture production with less danger of washing than if they are used for row-crop production. Market outlets are not available or in prospect for the production from very large acreages of cash crops. A recent study has revealed that the dairy cow contributes more than any other factor to the stability of irrigation farming in the Northwest.

On the basis of probable cropping systems, probable crop yields, and feed requirements for dairy stock, the annual production of butterfat on the Columbia Basin project, when it is fully developed, has been estimated to exceed 60 million pounds. This is equivalent to over 70 million pounds of butter. Butterfat production in Washington was approximately 79 million pounds in 1938, so that the development of the Columbia Basin will nearly double present production in the State. Where can a market be found for this volume of dairy products?

Markets for dairy products of the Columbia Basin will be found in several places. The farmers of the basin will consume milk, cream, butter, and cheese, as will the residents of the towns in the area. It seems unlikely, however, that more than one-fourth of the milk produced will be used within the area. The urban localities in western Washington and western Oregon consume a large volume of dairy products, but near these towns and cities are farming areas with a heavy production of milk. Extensive development of cheap power will undoubtedly stimulate industrial development in the Northwest. Even when full consideration is given to this factor, it does not seem probable that the markets of the Northwest can absorb all the dairy production of the Columbia Basin. One heavy deficit area for dairy products is California; butter and cheese are now moving into that market from Oregon, Idaho, Utah, Colorado, and other States.

If the California markets cannot absorb all the dairy production of the Columbia Basin and other new projects, then butter and other dairy products must move to the Midwest and East, or abroad. The price of butter in Pacific coast markets now generally exceeds the price in Chicago, whereas if butter moved east from the Pacific coast, prices in markets of the latter area would have to be lower. If the volume of dairy production on the Pacific coast exceeds the capacity of the markets of the area to absorb it, a fall in price is inevitable. Markets for dairy products in the Orient or in Europe might be developed as a result of our national policy after the war. In the past, the United States has been unable to sell butter abroad in competition with New Zealand and other surplus areas. Unless heavily subsidized by the Government, an export trade in butter could develop only with substantially lower prices, in relation to prices abroad, than have previously prevailed.

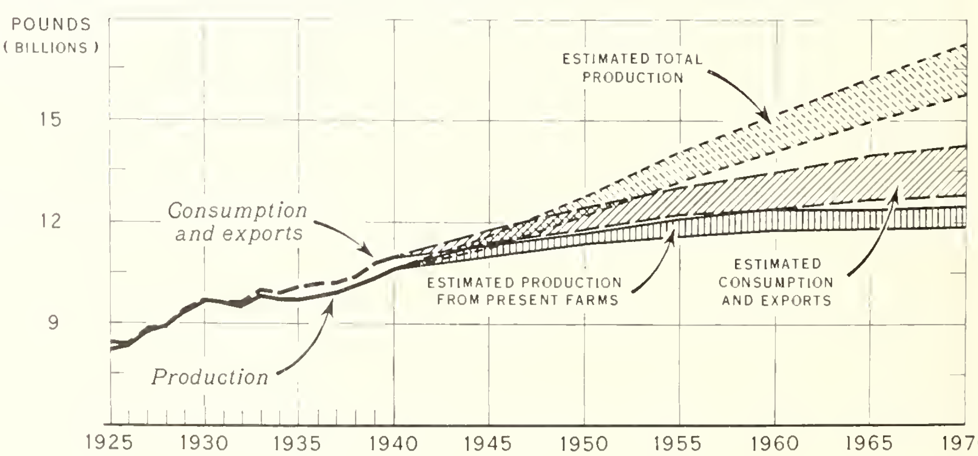
In moving to the markets of the Pacific coast, dairy products from the Columbia Basin must meet the competition of all present farming areas and of all new lands that may be developed. Since dairy products of the Columbia Basin must seek outside markets, and since they will have no monopoly in those markets, it is necessary to consider production and consumption in the entire Pacific slope. For purposes of this study, the States of Washington, Oregon, Idaho, Montana, Utah, Nevada, Arizona, and California were designated the "Pacific slope."

Probable Changes in Dairy Production

Dairy production from present farming lands in the Pacific slope may increase or decrease over a period of years. Factors that might lead to an increase in production would be a larger proportion of the cropland in feed crops, higher yields of feed crops, use of a larger proportion of available feed for dairy cattle, and higher milk production per cow. Factors that might lead to a decrease would be loss of croplands through erosion or seepage, introduction of new pests or diseases, and similar factors. In this study, assistance was secured from agricultural college specialists and from numerous people in the Department of Agriculture. Estimates of changes in production from existing farms were made for each State in the region. The average of these estimates by States indicated that dairy production from existing farms would increase about 15 percent for the region as a whole by 1970. It seemed probable that half of this increase would take place by 1950, and that increases after 1950 would be slower.

Further increases in dairy production on present farming lands may also result if supplemental irrigation water is provided, while irrigation of previously nonirrigated land is

ESTIMATED PRODUCTION AND CONSUMPTION OF DAIRY PRODUCTS, WHOLE MILK EQUIVALENT, SELECTED WESTERN STATES, 1925-70*



* WASH., OREG., IDAHO, CALIF., ARIZ., NEV., UTAH, AND MONT.

U. S. DEPARTMENT OF AGRICULTURE NEG 39606 BUREAU OF AGRICULTURAL ECONOMICS

sure to result in increases. Most irrigation development, but not all of it, will be made by the Bureau of Reclamation. For this study of markets, the Bureau estimated its probable construction program for a period of years. Fortunately, from studies carried on by the Department of Agriculture and cooperating agencies, estimates were available on possible other new land development. Some cut-over land will be cleared, and other lands will be provided with drainage, during the next two or three decades.

5,000,000 New Acres

Cut-over land that will probably be cleared in the Pacific Slope during the next 30 years is estimated at over one-half million acres (table 1). Drainage may account for only about 100,000 acres. This does not include drainage provided as a supplement to irrigation development. Supplemental irrigation by the Bureau of Reclamation, excluding certain projects which primarily are to substitute a different water supply for that now used, is expected to exceed 3 million acres by 1970. Other supplemental irrigation may approximate 1 million acres in the same period. New land irrigation prior to 1970 by the Bureau of Reclamation is estimated to be about 1 million acres in the Columbia Basin and 2 million acres elsewhere in the eight States of the region, and new land irrigation by other agencies or private groups may be about one-half million acres.

Since these lands vary in productivity, they must be reduced to a common denominator if their acreages are to be compared. It was estimated that production from cut-over and drained lands would be increased about one-third in comparison with production of newly irrigated lands, and that supplemental water development would add 20 percent to the present productivity of lands receiving supplemental water. On this basis, the indicated land development in the Pacific slope in the next 30 years will result in an increase in productivity equivalent to nearly 5 million acres of newly irrigated land. This is an increase in productivity equal to between 40 and 50 percent of the productivity of present irrigated land in this region.

The effect of these land developments will be felt after varying periods of time. Supplemental water supply will generally result in an immediate increase in production, whereas irrigation of new land brings a gradual increase over a period of several years. It was estimated that land brought under irrigation in one 5-year period would generally be in full production only at the end of the next 5-year period, the development period thus averaging 7 or 8 years. The capabilities of each probable new project were estimated, and the probable amount of dairy production was calculated.

Consumption of dairy products will be influenced primarily by changes in population, and to some extent by other factors. The population of the Pacific Slope has increased from 3¼ million persons in 1900 to nearly 12 million in 1940. The rate of growth has slowed during the last decade, but has been best sustained in California. Over 60 percent of the population growth in the region since 1900 has occurred in California, and in 1940 considerably more than half of the total population of the region was in that State. The large numbers of people in California and its relatively high rate of growth are basic factors in its importance as a market for dairy products of the Columbia Basin.

Attempts to forecast future population growth may be widely in error. The present birth and death rates of the region are about in balance, so that further growth will be primarily due to migration into the region. Migration may be quickly speeded up or slowed down, depending upon how favorably jobs or other inducements available on the Pacific coast compare with economic opportunities in other parts of the country. The fact that population growth in the United States is slowing down means that fewer people will be available to migrate to the Pacific coast, unless other areas experience considerable losses in population.

The assistance of population experts and others was enlisted for this phase of the study. Varying forecasts of the future population of the region were obtained, from which was chosen the largest forecast that seemed likely to be realized. This forecast was for 13.3 million people in 1950, 14.3 million in 1960, and 14.9 million in 1970 (compared with 12.0 million people in 1940).

Production of dairy products on the Pacific Slope increased nearly one-third in the 15-year period before 1940, but consumption, together with exports to Alaska, Hawaii, and the Philippines, was slightly in excess of production. On a few occasions during the 15-year period there was a surplus on the Pacific Slope and butter moved eastward, but in general the region has been on a deficit basis.

Efficiency in Marketing Dairy Products

On the basis of detailed studies of the cost of making butter and other creamery products, it seems probable that efficient dairy manufacturing and marketing can result in savings of at least 2 cents per pound, compared with costs in most areas. Potential savings, therefore, may at least partially offset the probable loss in price when the Pacific Slope goes on to an export basis. The loss in price will be due to developments all over the region, not just to developments in the Columbia Basin, and it will affect all areas about equally. Savings in manufacturing and marketing costs can be secured more easily in the Columbia Basin than elsewhere, for in older farming areas, creameries, condenseries, and similar plants are now located, and any effort to change their location or area of business encounters strong opposition and involves large costs. In the Columbia Basin, on the other hand, dairy processing plants can be located and organized so as to result in low costs, without encountering the necessity for changing any existing set-up.

Low-cost dairy manufacturing and marketing require that three basic conditions be met. (1) The volume of business must be at least moderately large. In the Columbia Basin it has been estimated that a creamery which makes butter only should draw milk or cream from an area with at least 4,000 producing cows, and preferably from an area with more cows than that. If a dairy plant is to manufacture a full line of products, a still larger area is desirable. (2) The manufacturing plant must have a minimum of excess capacity. All major pieces of equipment must be able to handle the peak flow of milk, but should be fully utilized at this peak season. Idle machinery means extra costs. (3) The creamery or other dairy plant must receive all the milk produced in a given area, so that there is no duplication of collection routes. Collection is a major item of expense in processing and marketing dairy products, and when two or more trucks collect milk or cream in the same area, collection costs are increased materially.

An efficient, low-cost dairy processing and marketing organization can largely protect the settlers of the Columbia Basin against imminent declines in price. There is no reason to believe that such a low-cost system will evolve unguided. Settlers in the Basin must exercise some control over the marketing of their product, either through their own cooperative associations or by restrictions of some kind, if a truly efficient marketing system is to come into existence.

OWING to curtailed importations of olives, the Nation's demand this year has been supplied 88 percent by California's irrigated groves, as compared with 2 percent previously.

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder: Name	Low bidder: Address	Bid	Terms	Contract awarded
		1941						1941
1004	Central Valley, Calif	Nov. 4	Trashracks for river outlets and main-unit inlets, Shasta Dam.	Joseph T. Ryerson & Son, Inc.	Chicago, Ill	$130,000.00		Nov. 29
1007	Sun River, Mont	Nov. 10	Open drains, Greenfields division	Williams Construction Co	Helena, Mont.	44,880.00		Nov. 19
1002	Colorado-Big Thompson, Colo.	Nov. 4	Transformers and switching equipment for Green Mountain power plant.	Allis-Chalmers Manufacturing Co.	Denver, Colo	[1] 105,550.00	F. o. b. Kremmling, Colo	Dec. 1
				Pennsylvania Transformer Co.	Pittsburgh, Pa.	[2] 54,698.00	do.	Do.
				General Electric Co.	Denver, Colo	[3] 1,744.95	F. o. b. Kremmling Colo., discount 1 percent.	
				Allis-Chalmers Manufacturing Co.	do	[4] 37,800.00	F. o. b. Kremmling Colo	Dec. 1
				Kelman Electric & Manufacturing Co.	Los Angeles, Calif	[5] 2,460.00	do.	Dec. 12
				Memco Engineering & Manufacturing Co.	Long Island City, N. Y.	[6] 10,310.00	F. o. b. Kremmling Colo., discount 1 percent	Dec. 1
				do	do	[7] 260.00	F. o. b. Kremmling Colo.	Do.
				General Electric Co	Denver, Colo	[8] 3,774.24	do	
				Westinghouse Electric & Manufacturing Co.	do	[9] 9,875.00	do	
1005	Boulder Canyon, Ariz.-Nev.	Nov. 7	Generators for Units N-7 and N-8, Boulder power plant.	General Electric Co	Schenectady, N. Y	[10] 741,500.00		Dec. 1
1573-D	Boise-Anderson Ranch, Idaho.	Oct. 30	Construction of dormitory at Anderson Ranch Dam.	R. W. Whelchel, V. E. Park and G. R. Bunn.	Caldwell, Idaho	15,041.00		Nov. 13
1575-D	Hyrum, Utah	Oct. 27	Penstock for Wellsville Canal pumping plant.	Thompson Pipe & Steel Co	Denver, Colo	5,116.00	F. o. b. Hyrum, Utah; discount 2 percent.	Nov. 5
1578-D	Central Valley, Calif	Oct. 29	Motor-driven fish sweep for Balls Ferry fish trap.	Moffet Manufacturing Co	Oakland, Calif	1,000.00	F. o. b. Anderson, Calif	Nov. 13
1579-D	Boulder Canyon, Ariz.-Nev.	Nov. 3	Fabricated steel pipe, fittings and valves.	Reading Pratt & Cady Div., American Chain & Cable Co	Denver, Colo	[11] 6,308.53	F. o. b. Boulder City, Nev	Nov. 12
				U. S. Pipe & Bending Co.	San Francisco, Calif	[12] 16,100.00	Discount 1 percent	Nov. 22
1580-D	Columbia Basin, Wash	Nov. 6	Construction of sheet metal work for ventilating system, Grand Coulee power plant.	Fox & Co.	Denver, Colo.	13,448.25		Nov. 25
1009	Central Valley, Calif	Nov. 18	Gates and hoists for diversion tunnel at Shasta Dam.	American Bridge Co	do	[11] 56,593.00	F. o. b. Gary, Ind	Dec. 2
				Willamette Iron and Steel Corporation.	Portland, Oreg.	[12] 93,072.00		Do.
1581-D	Columbia Basin, Wash	Nov. 5	Grilles and register faces for ventilating system, Grand Coulee power plant.	Geo. T. Gerhardt Co., Inc.	San Francisco, Calif	2,435.00		Nov. 14
1582-D	do	Nov. 5	Carrier-current telephone terminal equipment, coupling capacitors and potential devices and carrier line traps, Grand Coulee power plant.	Westinghouse Electric & Manufacturing Co.	Denver, Colo	[11] 15,225.00	F. o. b. Almira, Wash	Nov. 22
				General Electric Co	Schenectady, N. Y.	[12] 32,300.00	do	Do
1583-D	Boulder Canyon, Ariz.-Nev.	Nov. 7	Structural steel for bus-structure extension, Boulder switchyard.	American Bridge Co	Denver, Colo	19,802.00	F. o. b. Pittsburgh, Pa	Nov. 21
1584-D	Parker Dam Power, Ariz.-Calif.	Nov. 10	Fabricated structural steel for Parker power plant.	Creamer and Dunlap	Tulsa, Okla.	12,706.15		Nov. 25
1586-D	do	Nov. 17	Fabricated structural steel for bus structure assembly, Parker switchyard.	do	do	30,699.73	F. o. b. Earp, Calif	Do.
D-38,133-A	Columbia Basin, Wash	Oct. 28	Steel reinforcement bars (8,320,000 pounds.)[15]	Inland Steel Co	Chicago, Ill.	[2] 40,490.62	F. o. b. Odair, Wash	Nov. 10
				Carnegie-Illinois Steel Corporation.	Denver, Colo	[13] 95,929.10	do	Nov. 21
				Bethlehem Steel Co.	San Francisco, Calif.	[4] 24,688.12	do	Do.
				Youngstown Sheet and Tube Co.	Youngstown, Ohio	[14] 68,024.24	do	Do.
A-44,495-A	Parker Dam Power, Ariz.-Calif.	Nov. 13	18,000 barrels of low-heat portland cement in bulk.	Monolith Portland Cement Co.	Los Angeles, Calif	32,940.00	F. o. b. Monolith, Calif.; discount 20 cents per barrel.	Dec. 1
48,902-A	Central Valley, Calif	Nov. 12	Steel reinforcement bars (329,210 pounds).	Colorado Builders Supply Co.	Denver, Colo	11,960.49	F. o. b. Minnequa, Colo	Nov. 22
22,522-A-2	Boise-Anderson Ranch, Idaho.	Nov. 17	Steel reinforcement bars (1,433,676 pounds).	Carnegie-Illinois Steel Corporation.	do	[1] 13,630.32	F. o. b. Mountain Home, Idaho.	Nov. 29
						[2] 20,457.49	do	Do.
						[3] 12,373.31	do	Do.
B-33,531-A	Yakima-Roza, Wash	Nov. 18	7,500 barrels of modified portland cement in paper sacks.	Superior Portland Cement Inc.	Seattle, Wash	15,675.00	F. o. b. Concrete, Wash.; discount 10 cents per barrel.	Do.
1008	Central Valley, Calif	Nov. 12	Power transformers, Keswick power plant.	General Electric Co	Schenectady, N. Y.	559,785.00	F. o. b. Redding, Calif	Dec. 2
A-33,457-A-1	do	Nov. 19	Steel reinforcement bars (4,400 tons).[15]	The Youngstown Sheet and Tube Co.	Youngstown, Ohio	[1] 45,150.00	F. o. b. Indiana Harbor, Ind.; discount ½ percent.	Dec. 4
				Carnegie-Illinois Steel Corporation.	Denver, Colo	[3] 55,067.25	F. o. b. Coram, Calif	Dec. 8
				Columbia Steel Co	San Francisco, Calif	[4] 40,763.25	do	Dec. 4
				Inland Steel Co	Chicago, Ill	[5] 48,588.75	do	Do.
1003	Boulder Canyon, Ariz.-Nev.	Nov. 6	Lightning arrester and power transformers for Units N-7 and N-8 Boulder power plant.	Westinghouse Electric & Manufacturing Co.	Denver, Colo	[16] 334,902.00	F. o. b. Boulder City	Dec. 5
F-23,234-A	do	Nov. 18	Materials, including services of supervising engineer, for modernizing four 287-kilovolt oil circuit breakers in city of Los Angeles switchyard.	do	do	120,000.00	F. o. b. E. Pittsburgh, Pa	Dec. 6
A-33,456-A	Central Valley, Calif	Oct. 31	Pipe and fittings	Charles S. James Co	San Francisco, Calif.	[17] 21,825.64	Discount ½ percent	Dec. 3
D-38,158-A-1	Columbia Basin, Wash	Nov. 6	Steel reinforcement bars (627,000 pounds).	Bethlehem Steel Co.	do	21,785.40	F. o. b. Odair, Wash.; discount ½ percent on b. p. v.	Dec. 1
A-33,457-A	Central Valley, Calif	Nov. 1	Steel reinforcement bars (415,000 pounds).	Columbia Steel Co	do	[18] 12,011.00	F. o. b. Coram, Calif.; discount ½ percent.	Nov. 13
1001	Boulder Canyon, Ariz.-Nev.	Nov. 3	Turbines and governors for Units N-7 and N-8, Boulder power plant.	The Baldwin Locomotive Works.	Eddystone, Pa	[19] 679,200.00	F. o. b. Eddystone, San Francisco, and Rockford, Ill.	Dec. 10

[1] Schedule 1. [2] Schedule 2. [3] Schedule 3. [4] Schedule 4. [5] Schedule 5. [6] Schedule 6. [7] Schedule 7. [8] Schedule 8. [9] Schedule 9. [10] Schedule 1, (N-7 only). [11] Item 1. [12] Item 2. [13] Schedule 1, 7, 8, 9 and 10. [14] Schedules 5 and 6. [15] Contract price to be price at time of shipment. [16] Schedules 3 and 4. [17] Schedules 1 and 4. [18] Schedules 9, 10, and 11. [19] Schedules 1 and 3 (unit N-7 only).

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RESOLUTIONS ADOPTED AT THE PHOENIX CONVENTION

OF INTEREST to all patrons of Reclamation are the resolutions adopted by the National Reclamation Association at its tenth annual meeting at Phoenix, Ariz., in October 1941. Among these are:

A resolution pledging full support in the present emergency:

"Whereas the President of our country has declared a state of national emergency as the result of international violence which threatens the security of our form of government, and therefore is the paramount concern of our people; and

"Whereas this grave emergency may be successfully met only through the unselfish, united, and sacrificial efforts of our citizenry: Be it

"*Resolved by the National Reclamation Association,* That it, as an association, and on behalf of its individual members, solemnly pledges to the country and to those charged with the grave responsibility of safeguarding its institutions, full support in effectuating this paramount objective; and be it further

"*Resolved,* That a copy of this resolution be transmitted to the President of the United States of America."

A resolution on administration of power:

"Whereas it appears that the Secretary of the Interior has created a separate division to administer power on irrigation projects; and

"Whereas on certain existing projects, where irrigation and power are owned and operated together, it is unfeasible and impractical to separate the same, and irrigation and power should be controlled and coordinated by such projects; and

"Whereas on such projects irrigation has the greater use and power is incident to irrigation, and the revenue from power is used to reduce the construction and operating cost of such projects: Now therefore, be it

"*Resolved,* That the National Reclamation Association at its annual meeting held in Phoenix, Ariz., on October 15 to 17, 1941, recommend to the Secretary of the Interior that legislation be enacted or present statutes be amended providing for an administrative procedure for the disposal of hydroelectric power made available by Federal multiple use reclamation projects always bearing in mind that reclamation is primarily in aid of irrigation; and be it further

"*Resolved,* That a copy of this resolution be sent to the Secretary of the Interior and the Commissioner of Reclamation."

A resolution on water filings:

"Whereas the right to regulate, control, and distribute the waters of all nonnavigable streams within a State is within the exclusive sovereign jurisdiction of the State; and

"Whereas Section 8 of the Reclamation Act contains a definite and specific provision requiring compliance with the State water laws and recognizes vested rights acquired thereunder; and

"Whereas the Flood Control Act of June 28, 1938, and later acts authorizing the construction of certain public works on rivers for flood control and other purposes; the Pope-Jones Act, otherwise known as the Water Facilities Act, authorizing the construction of water conservation and utilization projects in the Great Plains and arid and semiarid regions of the United States; the Case-Wheeler Act; the Taylor Grazing Act; and other acts authorizing the construction by Federal agencies of works for the control and use of waters in the Western States, contain no statement that the activities of the Federal Government, under the provisions of these various Federal acts, shall be carried out in conformity with State laws covering the ownership, control, and use of the waters of the Western States: Now, therefore, be it

"*Resolved,* That the National Reclamation Association recommends and reaffirms and urges in the strongest terms that these several acts, and all similar acts, be amended at the earliest possible date to include provisions requiring that in the prosecution of all works designed for water conservation and flood control and use the particular Federal agency or department involved, shall, in all respects, comply with State laws relating to the ownership, control, administration, and use of the waters of these Western States, as is now required by Section 8 of the National Reclamation Act; and be it further

"*Resolved,* That copies of this resolution be transmitted to the Governors, Senators, Congressmen, and attorneys general of the Western States, with a request for enactment by the Congress of the United States of amendatory legislation for carrying out the purpose of this resolution."

A resolution on post-defense preparation:

"Whereas the National Defense Program will require the postponement of many meritorious projects and extraordinary efforts on the part of all agencies for accomplishment; and

"Whereas there has been created under the Federal Works Agencies the Public Work Reserve whose duty it will be to prepare a reservoir of public work and service projects in all of the States and local governments to cover a six-year period of post-defense employment; and

"Whereas as defense activities diminish there will be need for many activities in the way of public work and service projects to provide employment: Now, therefore, be it

"*Resolved,* That the National Reclamation Association and its membership endorse the efforts of the Public Work Reserve and recommend that the members of the Association give all possible assistance in the setting up of a reservoir of useful and needful projects to meet post-defense employment in every State and local government of the Nation."

A resolution on Federal water project legislation:

"Whereas there is pending in the Congress of the United States a group of bills identified as "Regional or Valley Authority" legislation, each measure seeking to provide some form of centralized control over one or more of the major drainage basins of the Nation, and

"Whereas it is our conviction that this proposed legislation, if valid, would deprive the States of general jurisdiction over and inherent right in the distribution and use of the waters and the initiation of water rights within their boundaries; prevent the making of compacts between States governing the use of such waters; drastically interfere with the basic agricultural economy of many States; unnecessarily and unwisely centralize in new Federal agencies powers and duties that can be most efficiently and economically administered by the States; lead to the ultimate elimination of a substantial portion of the assessed valuations of the States, thereby bringing to an end tax revenues which in many instances have been hypothecated well into the future; and thus increase the burden on other taxable property, and tends to create an undesirable and monopolistic type of Federal agency; and

"Whereas existing agencies of the Federal Government, including the Bureau of Reclamation and Corps of Army Engineers concerned with the planning, construction, and operation of reclamation, power, flood control, and other projects such as are contemplated under said proposed authority legislation are well organized and fully competent to carry on each in its own sphere such planning, construction, and operation; and

"Whereas this Association recognizes that the use of water for irrigation is the necessary and fundamental asset of the arid or reclamation States and is unalterably opposed to the creation of any superagency or authority that would assume control or administrative functions contrary to or in conflict with the laws of constitutional provisions of the respective States, or in any manner infringe upon or impair the vested rights acquired by our people in western water resources by appropriation, use, and occupation, including the inherent right to accomplish works for the necessary regulation of all rights already acquired: Now, therefore, be it

"*Resolved,* That the National Reclamation Association commends the effective service of the Bureau of Reclamation and the Corps of Army Engineers and asserts its opposition to the enactment of said regional or valley authority legislation which would destroy their effectiveness and independence, curtail their functions and operations, or tend to transfer them along with their related projects to other government agencies; and be it further

"*Resolved,* That appropriate steps be taken by legislation, or otherwise, for the purpose of coordinating more effectively the activities of existing Federal agencies engaged in investigating, constructing, and operating projects for the development and utilization of water resources; and be it further

"*Resolved,* That this Association recommends that the Reclamation Act of 1902, as amended and as supplemented by the Reclamation Act of 1939, be amended to the end that the Bureau of Reclamation may function in accordance with the provisions of these basic acts, outside of the area to which its activities are now restricted; and be it further

"*Resolved,* That this Association urges that all Federal legislation relating to the control, regulation, and utilization of water in interstate river basins recognize fully the principle of equitable cooperation between Federal and State Governments, each operating within its constitutional limitations, and that it recognizes fully that the highest use of water shall be for domestic consumption and for growing crops, that multiple use reclamation projects should be so designed and operated that power production shall at all times be subservient to the needs of irrigation; and that in the allocation of repayable costs the problem of having power bear an appropriate share of these costs and of keeping the water users' obligations within their ability to pay may be met."

And, in addition, resolutions asking for coordination of effort to insure adequate labor for planting and harvesting in 1942; urging sugar legislation; urging no delay in authorization of Federal water projects essential to the public welfare; recommending amendment of the Internal Revenue Act to exempt from income tax Water Users' Associations operating National Reclamation projects; recommending the transfer to the Reclamation Fund of all reclamation and irrigation project lands; urging adequate appropriations for Wheeler-Case projects; supporting a coordinated forestry program to protect watersheds; encourging agencies studying the fundamental economic questions underlying land reclamation policies; urging support of snow surveys; supporting systematic collection of hydrologic and hydrographic data; urging the broadening of the Wheeler-Case Act to permit incorporation of authorization for flood control, wildlife, and other factors; and thanking those who aided in the convention.

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

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John C. Page, Commissioner   Harry W. Bashore, Assistant Commissioner

J. Kennard Cheadle, Chief Counsel and Assistant to Commissioner; Howard R. Stinson, Assistant Chief Counsel; Wesley R. Nelson, Chief, Engineering Division; P. I. Taylor, Assistant Chief; William E. Warne, Chief of Information; William F. Kubach, Chief Accountant; A. R. Golzé, Assistant Supervisor of Operation and Maintenance; Charles N. McCulloch, Chief Clerk; Jesse W. Myer, Assistant Chief Clerk; James C. Beveridge, Chief, Mails and Files Section; Miss Mary E. Gallagher, Secretary to the Commissioner

Chief Engineer's Office, United States Customhouse, Denver, Colo.

S. O. Harper, Chief Engineer; W. R. Young, Assistant Chief Engineer; J. L. Savage, Chief Designing Engineer; W. H. Nalder, Assistant Chief Designing Engineer; L. N. McClellan, Chief Electrical Engineer; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Engineer; I. E. Houk, Senior Engineer, Technical Studies; H. J. S. Devries, General Field Counsel; L. R. Smith, Chief Clerk; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Examiners of Accounts

Operation and Maintenance Division, 910 National Bank Building, Denver, Colo.

John S. Moore, General Supervisor; L. H. Mitchell, Irrigation Advisor; H. H. Johnson, Field Supervisor (headquarters at Great Falls, Mont.); T. W. Parry, Field Supervisor

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief Clerk	District counsel	
		Name	Title		Name	Address
All-American Canal	Yuma, Ariz.	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Altus	Altus, Okla.	Russell S. Lieurance	Construction engineer		Spencer L. Baird	Amarillo, Tex.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent		W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Anderson Ranch Reservoir	Mountain Home, Idaho	John A. Beemer	Construction engineer		B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant	Boulder City, Nev.	Ernest A. Moritz	Director of power	Gail H Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Construction engineer	Edwin M. Bean	W. J. Burke	Billings, Mont.
Buford-Trenton	Williston, N. Dak.	Parley R. Neeley	Resident engineer	Robert L. Newman	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	Spencer L. Baird	Amarillo, Tex.
Central Valley	Sacramento, Calif.	R. S. Calland	District engineer	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Kennett division	Redding, Calif.	Ralph Lowry	Construction engineer	F. W. Gilbert	R. J. Coffey	Los Angeles, Calif.
Friant division	Friant, Calif.	R. B. Williams	Construction engineer	Geo. H. Witte	R. J. Coffey	Los Angeles, Calif.
Delta division	Antioch, Calif.	Oscar G. Boden	Construction engineer	F. D. Helm	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Estes Park, Colo.	Cleves H. Howell	Acting supervising engineer	C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex.	Charles P. Seger	Acting construction engineer	William F. Sha	Spencer L. Baird	Amarillo, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Supervising engineer	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Deschutes	Bend, Oreg.	D. S. Stuver	Construction engineer	Noble O. Anderson	B. E. Stoutemyer	Portland, Oreg.
Eden	Rock Springs, Wyo.	Thomas R. Smith	Construction engineer	Emanuel V. Hillius	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz.	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Reno, Nev.	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	Irvin J. Matthews	Construction engineer	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Mancos	Mancos, Colo.	Albert W. Bainbridge	Resident engineer	Harry L. Duty	J. R. Alexander	Salt Lake City, Utah.
Mann Creek	Weiser, Idaho	Louis B. Ackerman	Resident engineer	Ralph H. Geibel	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	Harold W. Genger	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Stanley R. Marean	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Mirage Flats	Hemingford, Nebr.	Denton J. Paul	Construction engineer		W. J. Burke	Billings, Mont.
Moon Lake	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Newton	Logan, Utah	I. Donald Jerman	Resident engineer	Hugh E. McKee	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Superintendent of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Ogden River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam power	Parker Dam, Calif.	Samuel A. McWilliams	Construction engineer	George B. Snow	R. J. Coffey	Los Angeles, Calif.
Pine River	Vallecito, Colo.	Charles A. Burns	Construction engineer	Frank E. Gawn	J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rapid Valley	Rapid City, S. Dak.	Horace V. Hubbell	Construction engineer	Joseph P. Siebeneicher	W. J. Burke	Billings, Mont.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	Spencer L. Baird	Amarillo, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
San Luis Valley	Monte Vista, Colo.	H. F. Bahmeier	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent		W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Construction engineer		W. J. Burke	Billings, Mont.
Sun River	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River storage	Reno, Nev.	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Tucumcari	Tucumcari, N. Mex.	Harold W. Mutch	Resident engineer	Charles L. Harris	Spencer L. Baird	Amarillo, Tex.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir superintendent		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	Herman R. Elliott	Acting construction engineer	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	David E. Ball	Superintendent	Alex. S. Harker	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Construction engineer	Geo. A. Knapp	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Jacob T. Davenport	R. J. Coffey	Los Angeles, Calif.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg.	A. Oliver	President	Marion Hewlett	Keating.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont.			Elsie W. Oliva	Hamilton.
Boise	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise	Black Canyon irrigation district	Notus, Idaho	Chas. W. Holmes	Superintendent	L. M. Watson	Notus.
Burnt River	Burnt River irrigation district	Huntington, Oreg.	Edward Sullivan	President	Harold H Hursh	Huntington.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Sheffer	Superintendent	Ralph P. Scheffer	Huson.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo.	S. F. Newman	Superintendent	A. W. Lanning	Austin.
Grand Valley Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	Jack H Naeve	Superintendent	C. J. McCormick	Grand Jctn.
Humboldt	Pershing County water conservation district	Lovelock, Nev.	Roy F. Meffley	Superintendent	C. H Jones	Lovelock.
Huntley	Huntley Project irrigation district	Ballantine, Mont.	S. A. Balcher	Manager	H S. Elliott	Ballantine.
Hyrum	South Cache W. U. A.	Logan, Utah	H Smith Richards	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly	Horsefly irrigation district	Bonanza, Oreg.	Benson Dixon	President	Dorothy Eyers	Bonanza.
Lower Yellowstone	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
	Fort Belknap irrigation district	Chinook, Mont.	H. B. Bonebright	President	L. V. Bogy	Chinook.
	Zurich irrigation district	Chinook, Mont.	C. A. Watkins	President	H M. Montgomery	Chinook.
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	President	R. L. Barton	Harlem
	Paradise Valley irrigation district	Zurich, Mont.	C. J. Wurth	President	J. F. Sharples	Zurich.
Minidoka: Gravity	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	Frank A. Ballard	Rupert.
Pumping	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Moon Lake	Moon Lake W. U. A.	Roosevelt, Utah	H J. Allred	President	Louie Galloway	Roosevelt.
Newlands	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emergy	Fallon.
North Platte: Interstate division	Pathfinder irrigation district	Mitchell, Nebr.	G. H Storm	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division	Northport irrigation district	Northport, Nebr.	Mark Iddings	Manager	Mabel J Thompson	Bridgeport.
Ogden River	Ogden River W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden.
Okanogan	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt River	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Sanpete: Ephraim division	Ephraim Irrigation Co.	Ephraim, Utah	Andrew Hansen	President	John K. Olsen	Ephraim.
Spring City division	Horseshoe Irrigation Co.	Spring City, Utah	Vivian Larson	President	James W. Blain	Spring City.
Shoshone: Garland division	Shoshone irrigation district	Powell, Wyo.	Paul Nelson	Irrigation superintendent	Harry Barrows	Powell.
Frannie division	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Manager		Deaver.
Stanfield	Stanfield irrigation district	Stanfield, Oreg.	Leo F. Clark	Superintendent	F. A. Baker	Stanfield.
Strawberry Valley	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division	Fort Shaw irrigation district	Fort Shaw, Mont.				
Greenfields division	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla, East division	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Manager	H. D. Galloway	Montrose.
Upper Snake River storage	Fremont-Madison irrigation district	St. Anthony, Idaho	H. G. Fuller	President	John T. White	St. Anthony.
Weber River	Weber River W. U. A.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Ogden.
Yakima: Kittitas division	Kittitas reclamation district	Ellensburg, Wash.	G. G. Hughes	Manager	G. L. Sterling	Ellensburg

THE RECLAMATION ERA

FEBRUARY 1942

UNITED STATES

DEPARTMENT OF THE INTERIOR

Washington

ORDER NO. 1629

All employees and all bureaus of the Department of the Interior hereby are placed on a war emergency basis. Actions upon matters resulting from declarations of war will have precedence over all other duties. Leaves and working schedules will be adjusted as may be necessary to this end. Heads of all bureaus of the Department are requested to report immediately to the Secretary any obstructive regulation, procedure, or working schedule.

Our immediate and primary function is the full mobilization of the Nation's natural resources for war. The successful conclusion of this war requires that our peace-time and defense jurisdiction over resources, including metals, minerals, petroleum and its products, solid fuels, electrical energy, and other physical items essential to our national survival, be placed upon a basis best suited to serve our military and naval forces without waste and with a view to saving all that we can of such resources for future generations.

Many members of the staff have asked how they may contribute most effectively to the service of the United States at this time. Except as individual services are required in the armed services and elsewhere, in addition to the 750 Interior Department employees already on active duty, all members of the Department of the Interior may contribute most effectively by efficiently and promptly directing all of their energy to the prompt and full mobilization of our natural resources.

And to win this war calls for the defeat of Hitlerism on the field of battle. Anything short of this would be but an armistice, during which the dictators would consolidate their gains and reorganize their armed forces for further conquests.

I am sure that no member of this Department will fail to contribute to the utmost in order to effect this result.

Harold L. Ickes

Secretary of the Interior.

THREE THOUSAND DEFENSE PLEDGES FOR $136,000

LAST summer Secretary of the Treasury Morgenthau invited the cooperation of Secretary of the Interior Ickes in the Treasury Department's campaign for the sale of Defense Savings Bonds and Stamps.

Secretary Ickes immediately appointed a Liaison Officer, Miss Mae A. Schnurr, of the Bureau of Reclamation, to conduct the campaign in the Interior Department. The wheels started moving to organize 50,000 employees of the Department located in the United States and its possessions. Forms had to be processed for making the necessary reports and other details of organization had to be effected. By the middle of September a voluntary and convenient participation program had been outlined and the first purchases made.

Washington offices are now completely organized and purchases through group agents are made each pay day. The results reflected in monthly consolidated reports in the 4-month period, September 1 to December 31, show that Washington personnel executed 3,362 pledges for the systematic purchase of bonds or stamps, for a total of $136,358, of which amount the Bureau of Reclamation subscribed $10,237, representing 101 pledges.

THE ERA'S COVER

Shasta Dam Cableway Headtower

INSIDE BACK COVER—One of Grand Coulee Dam's 11 Great Spillway Openings

THE RECLAMATION ERA

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Pages 29 and 48, *K. C. Dimmitt.*

CUT ALONG THIS LINE

(Date) . . . .

COMMISSIONER,
Bureau of Reclamation,
Washington, D. C.

SIR: I am enclosing my check [1] (or money order) for $1.00 to pay for a year's subscription to THE RECLAMATION ERA.

Very truly yours,

February 1942.

(Name) . . . .

(Address) . . . .

. . . .

[1] *Do not send stamps. Check or money order should be drawn to the Treasurer of the United States and forwarded to the Bureau of Reclamation.*

NOTE.—*36 cents postal charges should be added for foreign subscriptions.*

RECLAMATION MEETS THE CHALLENGE

By JOHN C. PAGE, *Commissioner*

Power, Water, and Food Production Geared to the War Effort Throughout 16 Western States

MEETING ITS SHARE *of the challenge hurled in the attack on Pearl Harbor, the Bureau of Reclamation has mobilized to make full contribution to the national war production effort laid down by the President in terms of planes, guns, and tanks.*

Girded for defense since the inception of the emergency, the Bureau's organization in 16 Western States was immediately thrown into higher gear to achieve effectively through its program of multiple-purpose projects certain major objectives, summarized as follows:

First: Power to overcome the supremacy of the Axis nations in electrical energy for the production of airplanes, warships, and munitions and for other vital services.

Second: Water for military centers, industrial and municipal purposes.

Third: Food, feed, and forage to meet the goals set by the Secretary of Agriculture in the Mountain and Pacific States, through assurance of irrigation water for established producing areas and for new land which can quickly be brought into production.

The Bureau is concentrating on these imperative objectives for the duration of the war. Simultaneously, it has constantly in mind and is pressing investigations for the development of a post-war program of feasible projects which can promptly be launched to provide employment and settlement opportunities for returning service men and industrial workers and to provide an outlet for the products of the industrial plants now being created to wage war.

Every War Dollar Demands 2¾ Kilowatt-Hours

WAR activity is more meaningful when translated into terms of electric energy rather than dollar expenditures. Energy makes the wheels go round; the wheels turn out the actual equipment. Experts assert that for every dollar expended in the war effort, 2¾ kilowatt-hours are required for the production of materials.

War Department officials place the cost of equipping an army of 3,200,000 at 20 billion dollars. In terms of electric energy this requires 55 billion kilowatt-hours, much of it on an annual recurring basis. In the many processes that go into the construction of a single $80,000,000 battleship, 220,000,000 kilowatt-hours are required. The production of a flying fortress calls for 637,000 kilowatt-hours. For 50,000 fighter planes of all types, more than 20 billion kilowatt-hours would be used.

The Nation is to lay out 56 billion dollars a year to preserve our American way of life, the President stated in his annual address to the Congress January 6. There will be required annually, therefore, 154 billion kilowatt-hours of energy—more than the total production for all purposes in the United States in 1940.

Since the power possibilities of the West have been under constant study in connection with the development and conservation of the land and water resources of the region, the Bureau was able last July to submit to a Senate subcommittee on Public Lands and Surveys a program of potential projects located west of the Mississippi River. These projects from which selections were proposed to meet the existing and prospective deficiencies, were capable of bringing in 9,000,000 kilowatts of power in new developments by 1946–47.

Bureau of Reclamation, 1942–45 Schedule

	Kilowatts
Installed December 31, 1941	1,144,462
Scheduled for 1942:	
Washington	
Grand Coulee L–2, January	108,000
Grand Coulee L–1, March	108,000
Arizona-Nevada, Boulder A–2, May	82,500
Idaho, Minidoka, May	5,000
Arizona-Nevada, Boulder A–5, August	82,500
Arizona-California:	
Parker, September	30,000
Parker, October	30,000
Parker, November	30,000
Additional 1942	476,000
Total, end of 1942	1,620,462
Scheduled for 1943:	
Colorado, Green Mountain, May	21,600
Arizona-California, Parker, July	30,000
Montana, Fort Peck, July	50,000
Washington:	
Grand Coulee L–6, July	108,000
Grand Coulee L–4, August	108,000
Grand Coulee L–5, September	108,000
Arizona-Nevada, Boulder N–7, December	82,500
California, Keswick, October	75,000
Additional 1943	583,100
Total, end of 1943	2,203,562
Scheduled for 1944:	
California, Shasta, January	375,000
Washington:	
Grand Coulee L–7, February	108,000
Grand Coulee L–8, May	108,000
Grand Coulee L–9, September	108,000
Additional 1944	699,000
Total, end of 1944	2,902,562
Scheduled for 1945:	
Idaho, Anderson Ranch	26,000
Arizona-Nevada, Davis, July	180,000
Colorado:	
Colorado-Big Thompson, May	68,000
Colorado-Big Thompson, June	36,000
Additional 1945	314,000
Total, end of 1945	3,212,562

What is the actual and potential power output at the command of the Axis nations? The declaration of war raises this question with added emphasis. In September at Los Angeles, a spokesman for the Federal Power Commission advised a group of western conservationists that the Hitler-dominated countries had 200 billion kilowatt-hours of electrical energy annually at their disposal.

Japan now has aggressively joined the Axis nations. This reservoir of productive enemy strength is increased to at least 230 billion kilowatt-hours.

Compare this with the 144 billion kilowatt-hours of energy the United States produced in 1940. Every kilowatt of power the Bureau of Reclamation can bring into production is needed. The Hitlerized nations control about 15,000,000 more kilowatts than are embraced in all of the power systems, public and private, in the United States.

It must be recognized also that the mobilization of power resources and production under Hitler means full use of all facilities, including power, for war and war alone.

When the Japanese hurled their first bombs, the scene of operations shifted to the West. Reclamation's work is in the West. And power is a large part of the Reclamation work.

The Bureau had 1,144,462 kilowatts operating under its jurisdiction when war was declared. Actively under way on January 1, 1942, was a Bureau program which by 1944–45 will triple the power now being sup-

plied on the Pacific coast and in the Intermountain region.

This schedule can be accelerated as the exigencies of the war are reflected in appropriations and priorities for critical materials. The volume of power now definitely planned by the Bureau is nearly twice the capacity operating in the 11 Far Western States in 1920. It calls for 476,000 kilowatts to be added by the end of 1942. In 1943 additions will bring the capacity to more than 2,200,000. In 1944-45 more than 3,200,000 kilowatts will be available to the Nation. With relatively little expansion, existing project facilities could be increased further to provide 4,000,000 kilowatts by 1945.

The additional requirement for power, measured realistically in terms of war demands, is nearly twice the pre-war estimate of last July. The job confronting the Nation and particularly the agencies which can produce power is plain. The Federal Power Commission estimates that one-half of the supply needed for war can be obtained through the diversion of energy to war activities, but points out that the remainder must be produced by new equipment to be installed by Federal agencies or private utilities.

Based on the best information available in the summer of 1941, the Bureau of Reclamation estimated that the minimum power requirements of the area west of the Mississippi under the defense program by 1945 would necessitate the installation of about 4,000,000 kilowatts of additional capacity. Reclamation projects and Bonneville Dam were to provide approximately half of this amount. As most of the private utilities in the area insisted that their equipment was adequate for future needs, the burden of meeting the emergency in the West rested on the Federal Government—the Bureau of Reclamation.

Since that time additional installations authorized for Grand Coulee and Boulder Dams have reduced the prospective deficiency as of 1945 by slightly more than 400,000 kilowatts. But despite these additions many strategic areas in the West will continue short of power under any circumstances. Under war conditions acute deficiencies will develop.

Reclamation Work Highlighted by Power

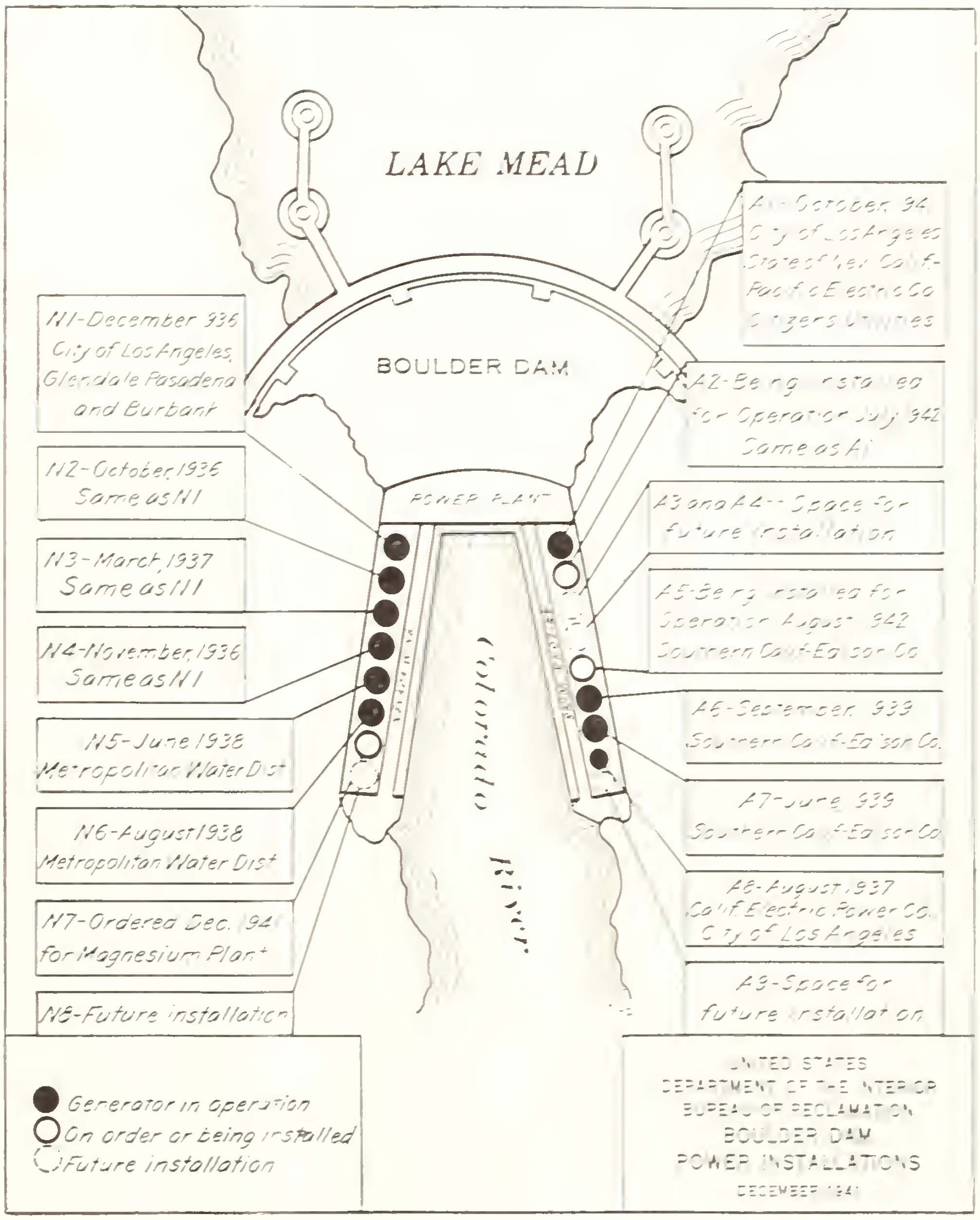
The Bureau of Reclamation stands ready to expedite installations at projects in operation, speed construction of dams where power can be produced, and inaugurate any new undertaking which can be completed in time to respond to the country's call for power service. Its program has been highlighted by power.

Boulder Dam on the Colorado River in the Pacific Southwest, even before the emergency, was supplying more than half of the power requirements of the metropolitan area of southern California. Today this largest power plant in the world, with nearly 800,000 kilowatts of capacity available and other installations under way, is making possible the manufacture of airplanes and other war material as well as providing electrical energy for a [illegible] and naval activity.

Boulder's giant generators [illegible] will [illegible] power for a new magnesium plant near Las Vegas, Nev. Magnesium is the [illegible] needed light metal used for planes, destroyers, and other war purposes. These units total big generators to be installed at Boulder Dam [illegible] its capacity [illegible] further expansion [illegible] the Bureau's [illegible] Parker Dam [illegible] Davis Dam [illegible] on the Colorado River [illegible] in 1944-45.

Grand Coulee Dam began [illegible] of power [illegible] March 22, 1941. It [illegible] the [illegible] to the Pacific Northwest [illegible] power. The [illegible]

Our biggest war ace in the hole for the Pacific Southwest. Boulder Dam's hydroelectric generators today run aircraft plants, steel works, other factories, copper mines, and, very soon, a large magnesium plant. The war effort of the entire Southwest is geared to Boulder's whirling dynamos whose installation status is shown on this chart. New generators are being rushed to operation, others have been ordered for expedited delivery. Boulder's present 787,300-kilowatt capacity will soon go over the million mark.



newly established plants, fed with power from the Bonneville-Grand Coulee transmission system, was sufficient in 1941 to furnish a supply of this vital metal for one out of every four airplanes produced in the United States last year. Magnesium plants, chemical developments, shipyards, and other industries in the Northwest are using Grand Coulee power.

By 1944-45, with 992,000 kilowatts, the capacity of Grand Coulee Dam will be exceeded only by the presently authorized capacity of Boulder Dam. Through a second powerhouse now under construction at Grand Coulee Dam, six additional generators could be made available as rapidly as manufacturers can make deliveries.

In northern California a few years ago private utility and other interests opposing the Central Valley project asserted there was plenty of power to meet all possible demands until 1945. Today Keswick and Shasta Dams on the Sacramento River are being rushed to provide heads for power plants which will place by 1943-44 a total of 450,000 kilowatts to meet mounting deficits in the heavily industrialized San Francisco Bay area.

In the Intermountain area, even with importations of power from Montana, the Utah-Idaho region is facing a shortage of power that retards the contribution its vast mineral resources can make to the war. The Anderson Ranch project in Idaho will throw 30,000 kilowatts into the breach. Contributions are being made by the power supply from the Minidoka and Boise projects in Idaho and by the Strawberry Valley plant in Utah.

In the Colorado area, where high-cost power has thwarted mineral developments, the Green Mountain plant of the Colorado-Big Thompson project will bring in 21,600 kilowatts during 1943. It is the first of seven plants of a project which involves the diversion of water from the Colorado River Basin through a 13-mile tunnel under the Continental Divide for a relief of hard-pressed agricultural land on the eastern slope of the Rocky Mountains. Through double and triple use of water, 160,000 kilowatts in six plants will be available by 1945. These plants will be interconnected with the Bureau's existing system which links the power plants on the North Platte, Kendrick, Shoshone and Riverton projects in Wyoming and serves military and other activities in the Wyoming, Colorado, Nebraska area.

Utilizing the waters of the Rio Grande stored in Elephant Butte Dam, a plant of 24,300 kilowatts began operation in 1940 and supplements the supply for military concentrations near the Mexican border in Texas and for important industrial developments in New Mexico. On the Salt River project in Arizona a group of plants with 72,000 kilowatts serves copper and other vital mineral developments as well as agricultural and commercial purposes.

Elsewhere small plants on the Yuma project on Arizona-California line, the Yakima project in Washington, the Grand Valley in Colorado, and the Newlands plant in Nevada fit into the normal and emergency needs of their respective communities.

The installed capacity on Bureau of Reclamation projects, most of which is devoted to the war effort, approximates the total installations of 1,161,000 kilowatts in the entire State of Texas. The dependable output of 4½ billion kilowatt-hours from the Bureau's plants approaches the 1940 production for the industrial State of New Jersey.

War developments have vindicated the foresight which is making possible ahead-of-schedule installations of power facilities at Boulder and Grand Coulee Dams.

II—Hong Kong Fell When The Water Failed

WATER, too, is a prime essential in war. Fresh in all minds is a stark illustration. Hong Kong fell when the water supply failed.

The second important contribution of the Bureau of Reclamation to the war effort is its work of providing supplemental water for municipal areas with populations upwards of 2,500,000. Extensive industrial and military concentrations are located in these areas. The Bureau of Reclamation is prepared, in addition, to meet critical domestic water situations confronting other areas in the West.

The Boulder Dam system on the Colorado River in the Southwest as constructed by the Bureau of Reclamation makes possible a supplemental water supply for Los Angeles and 12 other cities of the metropolitan area of southern California. This urban region is served by the Metropolitan Water District's 242-mile aqueduct, which carries water stored at Boulder Dam and diverted at Parker Dam to the coastal plain. The new magnesium plant at Las Vegas, Nev., which will depend on Boulder Dam for power will also obtain its supply of water from the same source.

Through the Rio Grande project in New Mexico and Texas, the water supply of the city of El Paso, Tex., is augmented to the extent that makes possible more extensive military concentrations in that important area.

The Central Valley project in California early provided through the Contra Costa Canal a fresh-water supply for industries in Pittsburg and other cities of the upper San Francisco Bay area. By regulating the flow of the Sacramento, by flushing back and replacing salt water with fresh, the project will serve further this industrial region.

Early completion of the aqueducts of the Provo River Reclamation project is essential to providing the cities of Salt Lake City and Provo with supplemental water supplies. Already important military and industrial concentrations in this Utah area with consequent increases in population are draining away the limited water supplies for domestic and agricultural purposes. The establishment of a large steel plant at Provo to meet pressing regional needs depends on an adequate supply of water from the Provo River project.

Industrial and agricultural centers on the eastern slope of the Rocky Mountains today look to the diversion of water from the Colorado River Basin to supplement their supplies for domestic and industrial purposes.

Still other Reclamation projects under construction which will provide municipal water supplies are the Altus project in Oklahoma and the Rapid Valley project in South Dakota. Altus and Rapid City will have new reservoir reserves when construction is completed. One of the new bombardment squadron air bases will be located at Rapid City. The increase in army personnel and population makes the added water supply essential.

III—Reclamation Has Ready 75,000 Inexhaustible Granaries

THE familiar assertion that an army travels on its stomach is an old-fashioned way of pointing out the importance of food in war. The need is no less even though the soldiers may fly or ride in trucks in modern war.

In a statement last September, Secretary of Agriculture Claude R. Wickard said:

"Of all the farm commodities of which increases are needed, the most urgent need is for milk. We need to consume more dairy products in this country for improved health and strength and the British will need tremendous quantities of cheese, evaporated milk and dried milk. To reach the production goals for 1942 the greatest effort will be required in dairying."

Since war came to the United States, the Nation is faced not only with the need for providing adequately for more than 125,000,000 persons on the home front but a possible armed force of 7,500,000 men in continental cantonments or in expeditionary forces to the Far East, Africa, or Europe. In addition, there is the obligation previously assumed of providing a steady stream of food to the British and others of the United Nations.

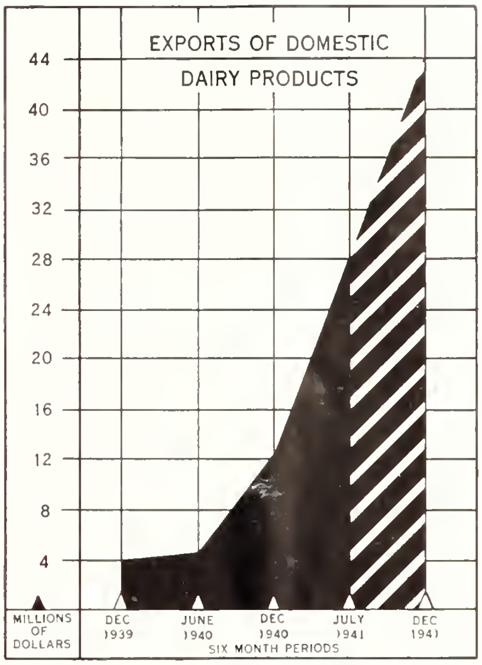
Adequate Water Always Assured

Reclamation project lands are assured of adequate water for irrigation. Come drought or wet cycles, they are prepared to answer the cry for increased food supplies. Alfalfa and other feed and pasture for dairy and beef cattle and sheep; fruits and vegetables, fresh and for canning, sugar beets and potatoes—supplies of all of these and many other essential commodities are assured through the present or expanded agricultural developments on 41 projects in 15 Western States.

More than 50 percent of the irrigated land in the West is devoted to alfalfa, pasture, and small grains which support the livestock industry of the region. Still further contributions to the country's food supplies can be made as Reclamation projects under construction are advanced to provide supplemental water or bring new land into production.

Production of milk has already been stepped up, but there is need for much more. The milk production goals set by the Agricultural Adjustment Administration of the Department of Agriculture for 1942 are 10 percent above the 1941 production, 14 percent above the 1940 record, and 15 percent above the 1939 production. It is probable that further increases will be necessary to maintain the tempo of exports to the Allied nations and to meet the domestic needs of our Nation at war.

The export of dairy products as reported



by the Bureau of Foreign and Domestic Commerce of the Department of Commerce for the 6-month periods ending December 1939 and July 1941, respectively, shows an increase of over 700 percent. The accompanying chart indicates that if the trend continues, the increase from the 6-month period ending December 1939 to the 6-month period ending December 1941 will be approximately 10 times that, or 1,000 percent.

A 1942 quota calling for an 18-percent increase in production of milk over 1939 has been assigned the 11 Pacific Coast and Mountain States. This goal is not only a very significant share of the total national increase, but also reflects a strategic consideration. The Pacific coast is on an import basis for dairy products, and the demand is constantly outstripping the supply. With the placing of war industry plants in areas heretofore sparsely populated, with the likelihood of greater troop concentrations on the Pacific coast, and with the definite possibility of expeditionary forces based there, much of the processed dairy products will have to be shipped across the country, east to west. Every pound of milk produced in the West for consumption in the West will reduce the load on transcontinental freight lines, already overtaxed with material that must come from the East.

Irrigation farmers in the West are major producers of alfalfa and irrigated pasture. In the face of the new demands for food, production must be increased by improved farm practices, better use of irrigation water, and by efficient fertilization. Areas hitherto unirrigated or idle for which irrigation facilities and a water supply exist must be placed in production for forage crops. Increases in immediate production of milk must come largely through better feeding for the reason that building dairy herds requires more time than the existing emergency allows. The planned increase in the number of dairy cows for 1942 over 1939 is less than 2 percent.

Although emphasis has been placed upon the shortage of milk and processed dairy products, production of fruits and vegetables must also be increased. The present export demands are for canned, dried, or juiced fruit, for fruit pectin, for canned tomatoes, and for dry beans. The prospective needs of the war will exceed current production. Again, the demand must be met by better, more efficient production from the existing base, rather than through ill-planned increases in acreage. Many years are required to bring fruit trees to a bearing age; acute labor shortages were encountered in harvesting the West's tomato acreage in 1941. The citrus areas of the West, developed by and dependent on irrigation will provide a major source of the antiscorbutic vitamins for the armed forces.

Of agricultural commodities, the most critical deficiency is in wool. The Office of Production Management has said that the entire 1942 clip will be needed for the Army. The 1941 domestic wool production of 460,000,000 pounds was supplemented with imports of wool totaling 540,000,000 pounds for the 7 months ending July 1941. Imports increased to this figure from a little less than 130,000,000 pounds for the 6 months ending January 1940.

To fully equip one American soldier, it is estimated, requires approximately 26 sheep producing 199 pounds of grease wool. On this basis the personnel requirements alone for an army of 7,500,000 men would call for 195,000,000 fleeces weighing about 1,500,000,000 pounds. The country's stock sheep number 50,000,000. Four years would be required to supply this army from domestic production.

Just how far irrigation farmers can go toward meeting their quota of the desired increase in wool production for 1942 will depend, for the moment, upon how well they feed their flocks. Better feeding will result in more wool and in better lamb crops. Irrigation provides the means whereby feed

See CHALLENGE, *page 47*

WITH THE LOOK OF

The Sculptures at Boulder Dam—Part I.

MR. HANSEN here does what rarely an artist can. He tells with thrilling frankness how a great work came into being and what it means to its creator. Mr. Hansen was appointed by Secretary Harold L. Ickes consulting sculptor of the Bureau of Reclamation after a national competition in search of suitable designs. His monument has been admired by millions.

THE SCULPTURES on the Boulder Dam adorn a major structure of our times. The dam represents the building genius of America in the same sense as the Pyramids represent that of ancient Egypt, the Acropolis that of classical Greece, the Colosseum that of Imperial Rome, and Chartres Cathedral that of the brooding religious fervor which was Gothic Europe.

Each in turn is a monument to collective genius exerting itself in community efforts around a common need or ideal. In each, and in the purposes which called them into being, may be read the mental timbre of the builders, their realistic visions, their fallacies as well as their glories—those tidal cycles of reason which are the causations behind the will of races and nations to live or to die.

To the final adornment and completion of these structures a sculptor was assigned. It was necessary to adorn Boulder Dam with sculptures because it is true of sculpture that it gives meaning to man's other works by interpreting man to other men in the terms of man himself. Sculpture presents a synesthesia based upon the origin, evolution, and racial architecture of the human mind and body.

A pyramid, for instance, may present a complex of awe, wonder, and bewilderment to the modern mind. Offhand, such structural prodigies may impress one as works of some race entirely alien in mind and body to our own. (I noted that the stupendous scale of Boulder Dam produces upon the average visitor a similar effect.) The public ask themselves about the builders, "What manner of men were these?"

Then, as now, the sculptor answers objectively through an art which presents the man. To us comes a smile of recognition when we note that the Pharaoh Khafre had a frame which would have sustained an all-American fullback and a face which would have insured his election as alderman in *our* first ward. We look upon the carving of this majestic gusto of 5,000 years ago and decide that this Pharaoh certainly must have been a product from the main stem of the human race.

The historic mission of sculpture is therefore to evoke a pungent realization of man and to make this realization nearly imperishable against the oblivion imposed by time. It may also shape a symbolism in human form in order to convey the very best within the reach of the aspirations and endowment of the race.

In nature the gift of all favors may not be projected into the keeping of one personality. Her wise decree ordains that physical and mental capacities should differ. On the other hand a sculptor may show in a single symbolic image the potential nobility of the race of men. The Boulder Dam is an achievement of peace, and the sculptures there could be dedicated to the finest traditions within the reach of the art.

In such a place as the Boulder Dam, a monument becomes a universal as well as a personal experience. People will not condone the reflection of their own faults in a public monument. That sculpture which draws general approval from a majority in its time therefore reflects in a peculiar sense the aspirations of that milieu.

The second stage in the appeal of a successful monument is the apprehensive curiosity it provokes. *Apprehensive*, because a human being is also a cagey animal who wants to know at once the nature of any appeal which disturbs the even trend of that *inner code* by which he lives. The votary has an immediate need to know how a monument is able to reach into his *own* emotions.

This is legitimate curiosity. It results in such questions as "How do you begin?" and "How do you do it?" How it is done, I shall attempt to explain later.

The best I can do in telling how I begin for my layman inquirer is to give him an *inkling* as to why *a monument is a monument*. So I will endeavor to tell why the sculptures on Boulder Dam are seated and not standing, why their hands are up and not down, so to speak. I will try to tell you some of the thoughts you would find being weighed in my mind if you *could* come upon it directing my hands in their work.

You would then become aware that the sculptures on Boulder Dam result from my concise application of the knowledge that *the true nature of a substance determines its balance*. I use the word *balance* to convey an image of the characteristic gravitational relationship of a physical body, or of a person, to this universe of which we are a part. Of those human beings with exceptional mental and physical endowments, it is said that they are *finely balanced*. This is a literal as well as a figurative statement.

I hold the balance of a *person* to be established as the *law of his being* at the moment of conception. Not only is he then endowed with the hereditary attributes of species and race; but the *order* of his own individual life pattern is established as an *entity separate* from that of other beings. There is established a *unique magnetic field*. This magnetic field is the fulcrum against which the physical body is levitated into existence. It remains a constant so long as the *person* lives.

In conformity with the rhythm of a person's magnetic field his body cells live, grow, differentiate, and assemble to become the dimensional implements of his soul. In the flow of this rhythm move the creative impulses of *thought*.

When the memory of this magnetic pattern, or *balance*, is lost, the soul may no longer maintain direction and control over the component cells within the physical body. Some of these cells then divert their activities into *evolutionary directions unrelated to the person* of whom they are a physical part. Some may differentiate at random while other units cease to function. It is said of such a person that "he can no longer call his soul his own." It would be more correct to say that he can no longer call his body his own. A body loses *balance* and dies when it becomes progressively unrelated in its parts to the controls of that

EAGLES

By OSKAR J. W. HANSEN,
Sculptor

magnetic field established as the beginning of a *person.*

This is the "stuff" on which a person's dreams of life are made. Inversely, it may be the "stuff" on which the dreams of universes are made.

The *act* of living is therefore a *strife* to retain *balance.* A person strives thus during the entire waking state of his life. Some intensify their sense of *balance* in the steps of the ballet, some do the same with music and song, while others find it in activities of the mind while the seated posture of contemplation permits the body to follow the revolving Earth. A clown evokes our mirth and also our pity because he assumes balances exactly contrary to the true postures of the emotions he purports to convey. One thing in life is certain and that is, whichever occupation a person enjoys the most, it is bound to be one of those which coincide the closest with his *personal need* for keeping in *balance.*

Mental and physical fatigue causes temporary or progressive loss of control over the organisms of the body. After a certain number of hours a person must rest in freedom from this strife. Sleep, and in a larger sense death, perhaps, are the mechanics through which nature recharges the human battery.

There is *no fixed point of rest* from which a sculptor may project a figure in human likeness. He may not model the 2 feet on the ground and then evolve on top of these a figure either psychologically or structurally true to nature. His creation, like a human babe, must be first conceived in the mind as a personality. It must then be given structural attributes to implement that personality. The gravitational center of the mobile sphere of a cranium is therefore the *critical point* from whence a sculptor must begin. He then proceeds to plot the exact relationship of this *mobile* center to the gravitational center of Mother Earth.

Since man thus encases the *core of his being* within the thermos bottle of his cranium, it follows that all other members and organs of the human body are organized as specialized equipment ordained to move, defend, feed, reproduce, and maintain in gravitational *balance* the *being* who dwells *in space* within his cranium. It is then readily seen that the members and masses of the human body *must arrange* themselves around a *mean* line drawn from the gravitational center of the Earth to the center of that planetary mass which is a man's head.

You would find me continuing the projection of my sculptured figures on Boulder Dam by transposing my mental picture of a man's cranium and thinking about it in turn as though it were a heavy vessel filled with liquid which someone is trying to balance on top of a long pole. In my mind I would make the observation that, the vessel is very full and must be balanced neatly; or that, if it happened instead to be mostly empty, it could be carried at many a rakish angle. I would remember that Mother Nature carries those craniums which contain finely attuned thinking mechanisms in erect bodies with an unfaltering and confident stride. To others she may grant just sufficient balance to keep for them a precarious hold on life.

My thought would then record that there was a point in exact prolongation of the earth's radius where the vessel could be maintained in balance with a *minimum effort* and that away from this vertical there came an *acute angle* where it slid off the end of the pole. My practical conclusions would again transpose this picture for application to my human problem and it would be plain that, in between the perfect vertical alinement of a person and that acute angle where sensibility ends lie the *posture indexes* of *all human emotions.*

These postures may be matched to their corresponding reflexes in terms of angle and

The winged figures of the Republic

degree much as one would join cams in a worm-gear drive. There is an angle for doubt, for sorrow, for hate, for joy, for contemplation, and for devotion. There are as many others as there are fleeting emotions within the brain of each individual who inhabits the earth. Who knows not all these postures of the mind if he would but stop to think of them as usable factors for determining proclivities of character? It is a knowledge bred down to us through the past experience of the whole race of men.

Ordinarily these posture indexes of character are referred to as *expressions*. By adopting this common term we may say, then, that expressions are the bodily reflexes of mental efforts to keep in balance. Then mental efforts may be observed in terms of subtle inclinations of the head or of the whole body, in gestures of the hands, by the pointing of a finger, by the certainty or uncertainty of the stride, or they may be indicated through a mere fluttering of an eyelid as it veils with momentary secrecy the inner turmoil of a soul.

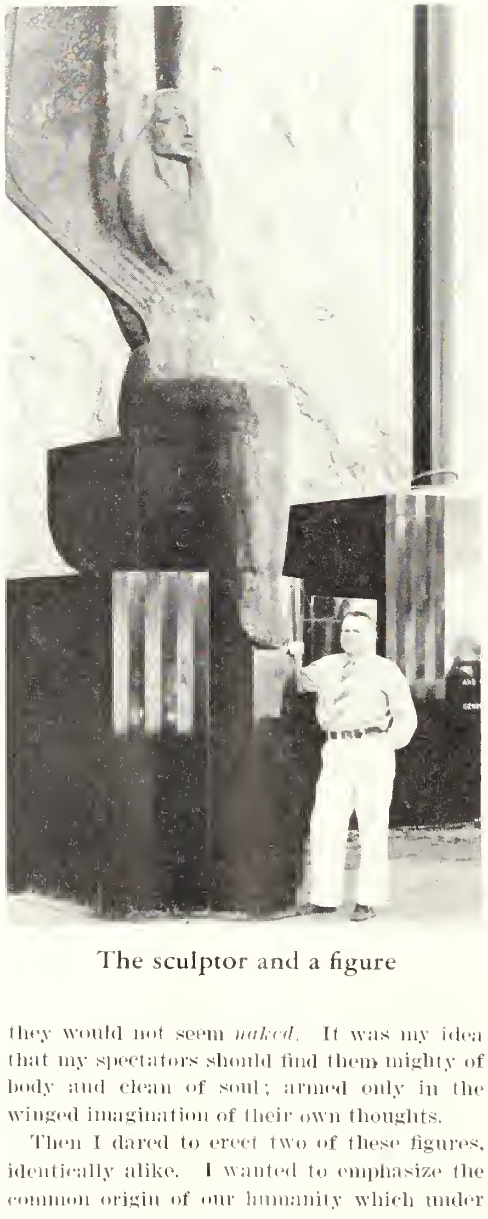
In practice, you would find me referring to posture angles as a writer would refer to the lexicon and dictionary, or an engineer to his tables and slide rule. I select for my figure in sculpture those angles which express the predominant emotions and characteristics of the personality I wish to evoke from the bronze or stone. In other words, I remember that through these postures and flexions of the bodily structure we transmitted thoughts of joy, menace, or fear long before men had the faculty of speech. I remember, while the spoken word may not state the truth, "actions speak louder than words"; and that postures may not for long be maintained contrary to the elementary *Truth* in a man. Any sculptor worth his salt should know that the expressions of a human body close around the core of a person's inner balance like a finely tailored garment.

If you then continue to follow my construction of the Winged Figures of the Republic on Boulder Dam, you would naturally expect me to concentrate first on the characteristics of the heads. There grew up with the settling of this continent a virile type of man, inured through constant adjustments into quickness of wit and beaten by privations and the strong winds of mountain and plain into a facial physiognomy with the look of eagles. It is the American type.

The craniums of the American type are finely shaped, high and domelike of forehead, lean of cheeks, and potentially sparse of words. If the eyes are said to be "the windows of the soul" then the eyes of the American type in their clear, piercing glance show the mental fire, daring, and imagination which crackle like burning coals within. Such heads contain a largeness of spirit, a willingness to assume risks for an ideal, ever lacking in a generation of shopkeepers.

The building of Boulder Dam belongs to the sagas of the daring. The winged bronzes which guard the flag therefore wear the look of eagles. To them was also given the vital, upward thrust of an aspirational gesture; to symbolize the readiness for defense of our institutions and the keeping of our spiritual eagles ever ready to be on the wing.

The building of Boulder Dam was a venture into the humanities. It was therefore not necessary to clothe these bronzes in any of the apparel, disguises, or trappings which the weak are prone to wear in order to seem great. I made these figures nude, but modeled them so



The sculptor and a figure

they would not seem *naked*. It was my idea that my spectators should find them mighty of body and clean of soul; armed only in the winged imagination of their own thoughts.

Then I dared to erect two of these figures, identically alike. I wanted to emphasize the common origin of our humanity which under our institutions is expressed in a Bill of Rights that is a law alike for rulers and for peoples. In the jealous guardianship of the sacred entity of individuals lie the potent powers of those who govern. In their common good will lies the security of the flag.

I said once before that a seated figure follows the rotating earth. The seated figure *maintains balance* by pivoting the upper body on the lower end of the spinal column and thus making the limbs available for angular braces against excessive body movements. The seated person may thus put *less effort* on keeping in *balance* and has *greater energy* for *external thought*. We seat a judge, or a presiding officer; we enthrone a king.

The Winged Figures of the Republic give evidence to the thought which preceded the reality of Boulder Dam and to that eternal vigilance which is the price of liberty.

REVENUES from the sale of electric energy from Boulder Dam and power plant since June 1, 1941, have been sufficient to warrant the making of initial payments of $300,000 each to the States of Arizona and Nevada, and of $500,000 to the Colorado River development fund, in accordance with the Boulder Canyon Project Adjustment Act.

Revenues from the power from Boulder Dam at the new rates of 1.163 mills per kilowatt-hour for firm energy and 0.34 mill per kilowatt-hour for secondary energy between June 1 and September 30 of the year 1941 were $1,614,000. These initial payments will take $1,100,000 of this sum and will leave $514,000 for operation and maintenance costs and replacement reserves.

These payments will be the first to be made under the adjustment act but they represent payments due for the year ended May 31, 1938. Like amounts are due for each succeeding year to date, and will become due in the future for each year until May 31, 1987. On that date the 50-year period ends during which the major cost of Boulder Dam and power plant will be repaid with interest to the United States.

The adjustment act, however, directed that these payments for periods already past should be made only out of revenues subsequent to the effective date of the act, May 29, 1941. The $15,773,734.51 earned and returned to the Treasury by energy sales from Boulder Dam before the adjustment act became effective therefore is not disturbed.

After the payments have been made in sufficient number to bring the account of the States and that of the development fund up to current positions, these payments will be made automatically on or before July 31 of each year.

The new energy rates established in the rewritten contracts authorized by the adjustment act will make possible a saving to the power consumers of the Pacific Southwest of about $120,000,000 in the 50-year repayment period.

GRAND COULEE DAM, the world's greatest single source of power, will produce sufficient electricity to illuminate a 60-watt lamp in every home in the United States.

THE Continental Divide tunnel of the Colorado-Big Thompson Project will be 13.1 miles long.

Nets Save Lives

on Pit River Bridge Construction

By FLOYD I. ROSS
Safety Engineer

ON THE *Central Valley Reclamation project, in California, safety nets were used in constructing Pit River Bridge, the highest double-deck bridge in the world, 500 feet above the river surface.*

THE OLD-TIME BRIDGEMAN who had a life expectancy of only about 7 years today believes sincerely in safety nets, just as he believes in hard hats and safety belts. He believes in them because now he can look forward to a life as long as that of any other construction man.

What the safety net means to the bridgeman has never been better illustrated than on the Pit River bridge being built by the Bureau of Reclamation in northern California on the Central Valley project. The bridge is a feature of the relocation of the Southern Pacific Railroad tracks and U. S. Highway No. 99 around Shasta Reservoir.

It is an outstanding construction job. The structure is big. It has an over-all length of 3,587 feet, contains 17,000 tons of structural steel and requires 340,000 field driven rivets. Fabrication of the main structure required the erection and removal of more than 2,000 tons of falsework.

The record height of the bridge—500 feet above the Pit River—made it necessary to give extraordinary attention to the conditions of safety under which the workers would have to labor. Other factors which necessitated unusual precautions were the wet winter weather, periods with comparatively high wind velocity, and the fact that 40 percent of the bridgemen employed were inexperienced in this type of steel erection.

On April 6, 1939, long before work on the bridge began, L. K. Reinhardt, engineer for the Industrial Accident Commission, and the writer reached the conclusion that safety nets would be necessary for the protection of the workmen.

Specifications for the Superstructure Required Safety Nets

Prior to January 16, 1940, when bids were called for the fabrication and erection of this bridge, safety recommendations requiring the use of safety nets were made to all prospective bidders by the Industrial Accident Commission. Specifications furnished prospective bidders definitely set out the details of the safety net to be used.

The contract for the bridge was awarded to the American Bridge Co. and erection was started in December 1940. In making the recommendation requiring the use of safety nets, it was stipulated that the nets must be put in place in each span ahead of steel erection and remain in place until all painting, deck work and paving were completed. Overcoming what some engineers thought an impracticality, the contractors were able to install a safety net for a span ahead of the erection of the steel by rigging seven-eighth-inch cable from the top of one pier to the top of the next and suspending the safety net from the cables.

As the steel was erected in each span, the safety nets were secured to the steel and spreaders were installed to maintain maximum width and minimum sag. The safety nets were cleaned of trash and old material and closely inspected for holes and broken strands each day. The bridgemen were constantly reminded that the safety nets must be protected and kept in the proper place. The superintendent of erection and the erection foreman were very zealous to see that all safety recommendations were strictly complied with.

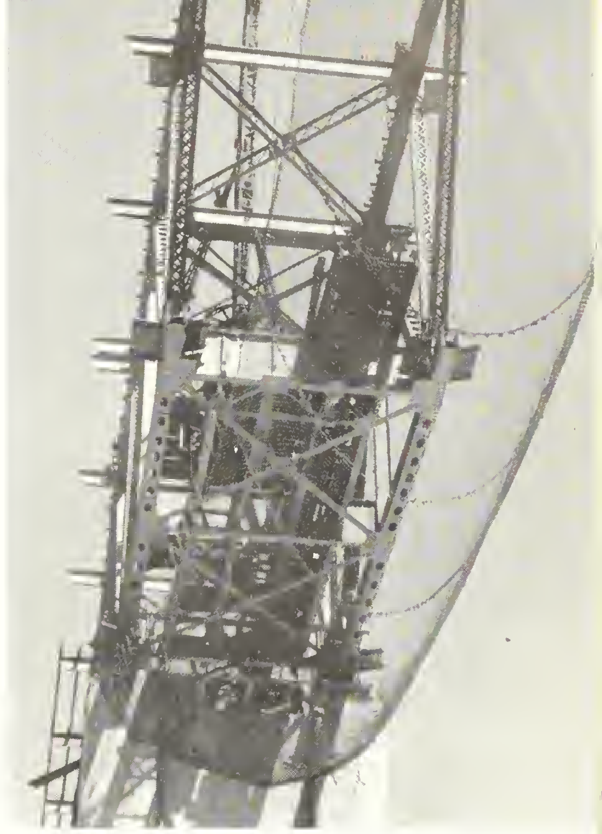
Three Men Fell—Two Saved

There have been 200,000 man-hours worked on erection. Work was carried on during 10 days of rain and inclement weather and on many days of high wind velocity, with 40 percent of the bridgemen inexperienced in this type of work. These unusual weather and labor conditions were not conducive to accident prevention. There were only three accidents in which the nets might have played a part, and the nets saved the lives of two of the three men involved.

The accidents were:

No. 1—On August 1, a painter fell a distance of 68 feet and struck the handrail on top of a concrete pier, missing the safety net by a few feet. Death was instantaneous.

No. 2—On September 8, the erection foreman, whose duty it had been to keep the safety nets properly suspended at all times ahead of where steel was being erected, fell a distance of 130 feet from the top chord into the safety net. The injuries which resulted from falling this excessive distance were: fractured leg, multiple abrasions and contusions which will cause approximately 8 weeks' loss of time.



Looking up at one of the safety nets

No. 3—On September 16, a painter fell from the lower chord into the safety net, a distance of approximately 11 feet. This fall resulted in no injuries other than shock and accounted for no loss of time.

Comments are:

Case No. 1—It was impractical to suspend safety nets over the small top area of the piers without interfering with the erection of steel.

Case No. 2—For many years employers have been reluctant to use safety nets on the premise that a worker could not survive a fall into a safety net from a height in excess of 30 or 40 feet. This case shows that workmen can fall from a height greater than 100 feet without being critically injured.

Cases Nos. 2 and 3—The facts show that had the safety nets not been used ahead of erection and properly suspended, both workmen would have fallen a distance in excess of 250 feet to the ground and fatal injuries would have resulted.

Edward Nimmergood, superintendent for the American Bridge Co. on the structure with over 30 years of experience in steel erection, makes the following comment:

"Safety nets on bridge erection are practical and can be used without retarding the progress of erection schedules. They not only protect the lives of experienced workmen, but give to the inexperienced bridgeman confidence to be able to work on structures of this height. Much can be done to alleviate unsafe working conditions on erection by anticipating and providing for safety nets and other safety features in the original design."

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"The biggest thing on earth" goes to work in earnest

Grand Coulee Dam Answers the Bugle

EIGHT years ago, when construction of the Grand Coulee Dam was first begun, only a handful of people were sufficiently visionary to see that the big structure one day would be a vital bulwark in the defense of the country.

But in 1940 and 1941 everyone understood its value as a national defense asset. Hitler was on a bloody rampage. Countries fell like grain before a scythe. England was in grave danger. The United States, violently shaken out of its lethargy, sprang into action. Tanks were needed, and ships, airplanes, guns, and the electricity to produce them.

Grand Coulee Dam was ready when the call to arms came. It answered with the huge block of energy to run the machines serving in the front lines, as truly as a battleship or a squadron of planes, providing a huge block of energy to run the machines that fashion material for the American arsenal.

The production of power for national defense was the outstanding accomplishment on the big project in 1941.

During this action-filled year, the 10½-million cubic yard structure was brought to virtual completion. In March, its two 10,000-kilowatt station service generators began supplying power to Pacific Northwest war industries, and in October a large 108,000-kilowatt unit took over their task. The machines delivered 204,858,000 kilowatt-hours of energy to the Bonneville Power Administration network during the year.

When 1942 arrived, Grand Coulee Dam's second hydroelectric unit was within a few days of going into commercial service, and construction of a third, scheduled to see duty in March, was well along. Others will be fitted into place, like peas in a pod, as fast as they can be obtained. In 1944, the first of two powerhouses will be fully equipped with its nine sets.

When the second dynamo began operating, the dam's installed capacity jumped to two-thirds that of Niagara, and 40 percent that of the now inactive Dneiper Dam in Russia. It exceeds the installation at Wilson Dam, and almost matches that on Conowingo. At full development, the plant will make available 1,944,000 kilowatts, the greatest block of electricity ever produced at one site. Like Boulder Dam, Grand Coulee provides one of the best means of rapidly expanding the country's power output.

The reservoir of low-cost electricity on the Columbia attracted large defense industries to the Northwest. One aluminum plant is operating at Vancouver, Wash., another at Longview, a third is under construction at Spokane, and consideration is being given to the building of additional factories.

Preparations for More Power

In the next few years the demand for energy by these and other plants is expected to exceed the 972,000 kilowatts to be provided by the first powerhouse. To meet that demand, the Bureau in December made arrangements with the contractor, Consolidated Builders, Inc., whereby the company was released of all minor work remaining on the dam proper to permit it to begin at once the erection of the second powerhouse, similar in size and capacity to the west shore station.

It was felt that this procedure was the quickest and cheapest way to complete the $3,000,000 structure, one of the largest concrete buildings on the Pacific coast. The contractor is on the ground and has the equipment at hand to do the work. It expects to complete the extra-work order, for which it will be paid cost plus 10 percent, in about 18 months, or possibly as early as the end of the year.

A recent deficiency appropriation made $6,000,000 available to begin work on the building and on three more generating units, in addition to the two now in operation and four now being installed or on order.

The December settlement stipulated that the Bureau take over work of the clean-up character which will cost about $175,000. If performed by the contractor, this work would have been paid for at rates established in the contract. Release from these contract obligations allows the company to concentrate on the more important undertaking, and at the same time permits the Bureau to coordinate these jobs with the installation of power machinery and transmission equipment.

The arrangement also provided for the contractor to renounce $154,661.64 in claims against the Government. The company had prepared requests for adjusted payments growing out of some 12,000 drawings which were revised as a result of a change order promulgated by the Secretary of the Interior, Harold L. Ickes, on March 4, 1939. These changes reflected improvement in designs which were worked out as the world's largest dam grew toward completion.

When the Government took over C. B. I's clean-up work, about 200 men were dropped from the company pay roll. The Bureau will not increase its forces to complete the work, because it will be coordinated with other operations, and will be spread over a greater length of time than proposed by the contractor.

As a necessary preliminary to the building of the new powerhouse, a large concrete transformer deck is being built by C.B.I. on an extra-work order basis. Construction has been under way since late October.

Initial production of power by the station-service units and the first of the main machines, the construction of the large trans-

former deck, completion of the dam, and signing of the extra-work order for the east powerhouse, highlighted 1941 progress on the project, but many other noteworthy operations were also carried on.

Other Notable Accomplishments

Clearing of the 151-mile reservoir, a project begun in the fall of 1938, was concluded in December. Trees, brush, old fences, abandoned buildings, and other debris were removed from the bed of the lake, one of the longest man-made bodies of water in the world. W.P.A. forces, using equipment supplied by the Bureau, cleared 53,860 acres, grubbed 11,426, and logged 32,568,442 board feet of merchantable timber, which was sold to a commercial sawmill.

Relocation of roads and railroads within the reservoir was a major operation, construction of 27 miles of Great Northern Railway, three major bridges, and 90.5 miles of State primary highway having been brought to completion. At the beginning of 1942, only 35 of 89 miles of secondary roads remained to be built.

At the year's peak, the reservoir was filled to nearly three-fourths its capacity, was 136 miles long, and at several points 2 miles wide. It will reach its full length of 151 miles next spring. At that time, the overflow will plunge down the spillway in a waterfall 1,650 feet wide and about 350 feet high.

The Little Dalles Channel of the Columbia, 135 miles upstream from the dam, was the site of additional reservoir activity. Backwater from the restriction, augmented by the creation of the reservoir, threatened to cause damage to property along the river between this point and the Canadian boundary at extraordinary high stages of the river. To widen this natural bottleneck, 323,711 cubic yards of solid rock were excavated.

Crest of Dam Completed

At the dam site, the contractor completed installation of 11 large drum gates, each 135 feet long and 28 feet high, in the spillway crest, a job begun in 1940. These will make it possible to pass over the spillway the river flow, less water passed through the powerhouse turbines and later that diverted for irrigation, while maintaining the reservoir surface at a fixed level. Their capacity is more than double the greatest flow recorded.

Above the million-pound drums were built 11 arch-type bridges, to carry the middle section of the 30-foot roadway which surmounts the crest of the dam. Due to the war situation, the driveway will remain closed to the public.

Slide trouble, a plague that has harassed the Bureau since construction began in 1933, caused a resumption of excavation work. The contractor removed 1,409,000 cubic yards of earth and 66,000 yards of rock from the west bank of the Columbia to prevent a major movement of material toward the tailrace of the west powerhouse. The 9-month job ended in August.

Another slide, upstream from the dam, much smaller than the aforementioned, wiped out a section of the main highway to the project. A concrete retaining wall was built to hold the roadbed in place.

Irrigation Program Not Overlooked

While power for defense "stole the show" at Grand Coulee, preparations for irrigating 1,200,000 acres of Columbia Basin lands were not slighted. The last three of the four basic surveys of project lands, retracement of section and quarter-section corners, the topographical survey, land classification, and appraisal, were completed. The first was finished in 1940.

Some of the crews employed on these surveys were transferred to work in connection with the canal and lateral lay-out. Other engineers continued investigation of sites for the two dams that will transform the upper Grand Coulee, a dry riverbed, into a balancing reservoir. This examination is scheduled to end in 1943.

Four Problems Completed

The hundred land-use and land-settlement experts studying the 28 problems of the joint investigations, the objective of which is the successful development of the Columbia Basin, have completed 4 of the problems and made much progress on the others. All are scheduled to be finished this year.

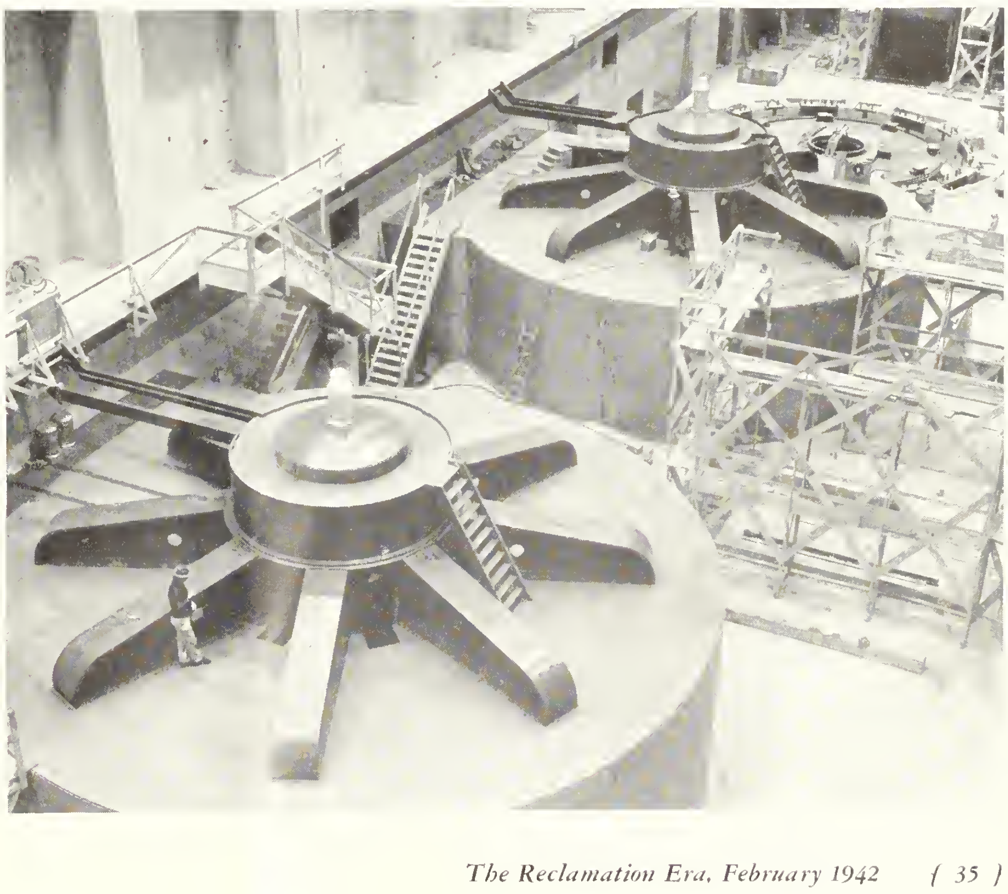
The first "graduates" from the "fish university," as the Leavenworth migratory fish-control hatchery is sometimes called, were released to the cold, cruel world last year. As part of the Government's program to perpetuate the salmon run of the upper Columbia River, adult fish are trapped at Rock Island Dam near Wenatchee, their eggs hatched, and offspring raised and released in tributaries below the Grand Coulee Dam. A second hatchery was constructed on the Entiat River, and another, on the Methow, is nearing completion.

Game Fish

The Columbia River Reservoir will be stocked with game fish. Construction of a hatchery at Chamokane Creek, near Ford, Wash., to supply the fingerlings, was practically completed at the year's end, and plans were being made to place it in operation early in 1942.

Intense building activity will continue on various parts of the project even though the main dam is virtually complete. In addition to the building of the east powerhouse, continued installation of generating equipment, erection of switching facilities, and completion of clean-up work, the Bureau will be engaged in relocating county roads near the Kettle River and near Hawk Creek, in relocating isolated sections of Indian Service roads on the Spokane River, and in doing other work.

Two Grand Coulee hydro giants, now roaring eternal defiance



Land Settlement

By CARL C. TAYLOR

Dr. Taylor, Head, Division of Farm Population and Rural Welfare, Bureau of Agricultural Economics, Department of Agriculture, originally presented this paper before the American Railway Development Association in Chicago.

THE HISTORY and evolution of American society has been, to a considerable extent, the history of new land settlement. From Jamestown and Plymouth in 1607 and 1620 to about 1910, the story was one of people moving constantly westward, each generation settling a new section of the continent.

When the Federal Government was founded, or at least just a few years afterward when the first Federal census was taken, there were less than 4,000,000 white settlers in the United States. Probably one-half of them had come directly from foreign countries, and the great majority of them were not living in the areas in which they were born. Needless to say, all of them, their parents and grandparents, lived in new-land settlements. By 1790, no colony had been established farther inland than 400 miles, and what might be called the line of frontier settlement averaged only about 250 miles from the Atlantic coast line.

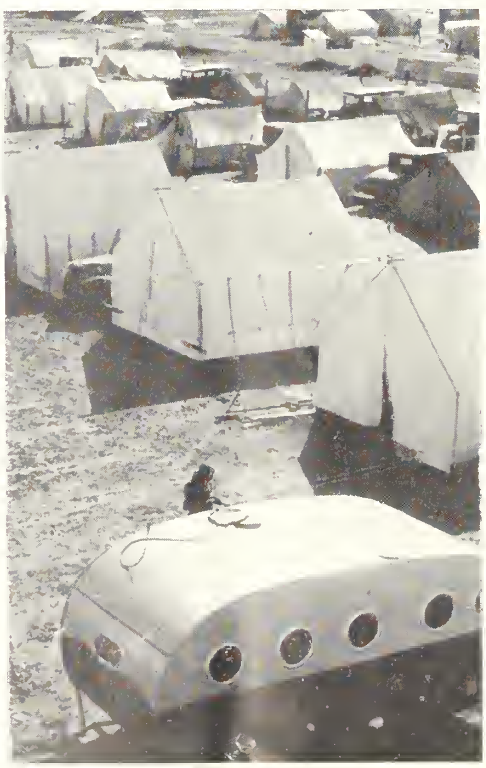
Shortly after the Government was founded, a march of population westward began which lasted for a full 100 years. Each generation found the frontier several hundred miles toward the West. Areas which themselves had been settled by migrants from farther east just a generation before, were supplying the new generation to settle areas west of them.

This movement can almost be visualized as a tide of population, each succeeding wave of which settled a whole new section of the continent. These waves rolled in about 30-year intervals, and thus each generation of Americans for more than 100 years was a generation of pioneers. Young families who settled western Pennsylvania, parts of Kentucky and Tennessee before 1820, saw their sons and daughters settle Ohio, Indiana, Illinois, Alabama, Mississippi, and Arkansas between 1820 and 1850. They saw their grandsons and granddaughters settle Iowa, Minnesota, and Wisconsin between 1850 and 1870. By 1870, the westward march had reached the semiarid regions of the Great Plains, had jumped these plains and begun settlement of the Pacific coast. Between 1870 and 1910, all of the intervening spaces had been occupied to some extent and the greatest era of new-land settlement ever to occur in the world, and the greatest area of new land ever to be occupied in an equal length of time, had marked the era.

Population movements have continued since 1910. Many of them are still into new-land areas, but some of them are movements out of areas whose natural resources could not support all the people who attempted to occupy their lands. Three States—Nevada, Vermont, and Mississippi—lost population between 1910 and 1920. Thirty-three States and the District of Columbia gained 10 percent or more in population during that decade. Between 1920 and 1930, a State that had been settled as late as Montana lost population. Furthermore, increases in population took place in only 30 other States and the District of Columbia to the extent of 10 percent or more. Everyone is acquainted with the fact that 6 States—the 5 Great Plains States and Vermont—lost population between 1930 and 1940. Not so many people are aware of the fact that only 17 States and the District of Columbia increased their population as much as 10 percent or more during this decade. Our population increases and our population movements are slowing down.

For some time in the future, however, we shall continue to be a mobile people, our migrants still seeking out potential areas for settlement and still withdrawing from areas which were unwisely settled in earlier decades. Some of the areas from which they will withdraw are areas into which so large a number of people should not have gone during the period of pioneering; others will be areas in which original settlement was thoroughly justified, but in which the natural resources have been so diminished that they will no longer support the population now residing there.

"Homes" on the westward march



All agencies and persons concerned with the destinies of new migrants are aware of the fact that unguided migration into, and unwise settlement of, areas with relatively poor natural resources have been exceedingly costly economically and even more costly socially. Such places have developed into problem areas that require heavy relief expenditures, and in which the whole level of life is thrown in jeopardy.

We have at least five large areas in the United States which can justifiably be described as problem areas. The Appalachian-Ozark Highlands ,the Lake States Cut-over area, the Great Plains, the eastern Cotton Belt, and the Spanish-American-Indian areas of New Mexico and Arizona are all areas in which the natural resources are not adequate to support the population now living there. These are not areas which should be completely abandoned, but either because the natural resources have diminished or because the population increases have been great, a population pressure upon the natural resources has resulted which has jeopardized the standard of living of the people.

Trends Should Guide Policies

An analysis of natural population trends, coupled with an analysis of relative, potential opportunities among the various geographic areas of the Nation, should guide future settlement policies and projects. I have already listed the broad deficit areas. There are, however, some surplus areas which in their natural development will accommodate more people than they are now supporting. Again, in very broad terms, I would name four such areas—Pacific Northwest, Mississippi Delta, Piedmont, and certain sections of Florida.

The Pacific Northwest is potential because of its irrigation possibilities. The Mississippi Delta is potential because of its drainage possibilities and certain sections of Florida are potential for the same reason. The Piedmont is a rapidly industrializing area, which means that urban population will increase and agriculture will become more intensive. There are undoubtedly numerous other smaller areas, but these are the ones into which we may expect fairly large population movements in the future.

There are at least 500,000 farm families now located on lands from which all or a portion must move if the resources of the areas in which they live are adequtely to support them. There are probably other areas in which they live are adequately to support this or a larger number of people in addition to those now there. American people cannot be moved, and will not move, on command like an army, but governmental policy and programs, and projects of private

enterprise can and should do much to stimulate and give direction to the future movement of population and thus to new settlement.

The homestead program and the railroads did more to guide migrations of the past than anything else. Theirs were the great settlement or resettlement programs while the continent was first being occupied by white settlers. Both of these programs made many mistakes, but out of their mistakes, and their successes, should come the wisdom with which to guide future migrations. This is assuming that there will be programs for such guidance, and that the Government and the railroads will be the two most interested agencies in the future, just as they have been in the past.

Large areas from which there should and probably will be considerable movement in the future are: (1) Areas in which lands should be evacuated or converted into less extensive uses; and (2) areas in which farms should be enlarged. For the sake of conservation of our natural resources, as well as for the adequate support of the families which live on those resources, some of our types of land should not be farmed so intensively. They should be converted from row culture to grass culture or from grass culture to timber culture. In either case, they produce less intensively and require fewer people for their operation.

In a number of other areas, the basic natural resources are sound, but the number of farm families and farms is too high. The farms need to be enlarged to furnish an adequate income for the support of the farm families. To expand these farms automatically means to eliminate some families.

Large areas of potential and prospective natural resource development to which people probably will and should move in the future are: (1) Future irrigation areas; (2) future drainage areas; and (3) areas of increasingly intensive farm production because of increasing industrial development. It is imperative, if we would offer sound guidance to future population movements, that we be sure of our facts concerning these areas and that we be prepared to give these facts to prospective settlers.

Pioneering and resettlement programs for our people in the future should benefit from our long and diverse experience of the past. Settlement policies and problems of the future will not be identical with those of the past, and therefore our future settlement policies should be considerably different from those which we have had thus far. Lands to be occupied in the future will not be free or cheap lands. Settlement areas for future development will hold no high prospects for speculative gain. Settlement policies and programs must therefore be wisely conceived and conservatively developed. They must guard against the mistakes of the past, but they must guard equally against utopian hopes for the future.

Between 1841, when the preemption law was passed, and 1862, when the homestead law supplanted it, land in new areas sold for as little as 12½ cents an acre. The cost of homestead lands averaged only about 50 cents an acre. The cost of new land today, brought in because of irrigation or drainage, will probably be $100 an acre or more.

There will not be much opportunity for speculative gain because of big increases in land values on lands that start at $100 or more per acre. Future pioneers cannot therefore expect to accumulate an inheritance from unearned increment.

For Iowa lands—some of which were preempted, some homesteaded, and some purchased from the railroads—average values were only $7 an acre in 1860. Within a decade, the lands had trebled in value; in two decades they had doubled that; and in 50 years from the time they were settled, they were selling for 20 times the amount they originally cost. In other words, a 160-acre farm in my home county—Shelby County, Iowa—was worth approximately $1,100 in 1860, but by 1910 it was worth $20,000. In 1920, it was worth $54,000. No such possibilities are in the books for future pioneers.

I would rather dogmatically prescribe the following elements for a future settlement program: (1) New-land settlements will be so expensive that incompetent farm families cannot be expected to succeed in farming them; (2) some control must therefore be exerted over the type of settlers who will come to new areas of settlement; (3) the new farms must be primarily the homes of families who know that they cannot make speculative profits on the lands and who will be not only satisfied but enthusiastic about making simply a good year-by-year living on their farms; (4) these families must build their lives on a philosophy of conservation and social and economic security rather than upon speculative gain and exploitation; (5) we must utilize the experience of past successes and failures—homesteading, railroad colonization, reclamation, and Farm Security Administration projects; (6) we must realize that the new pioneers are going to insist upon a number of modern conveniences and technologies which earlier pioneers did not have, but we must not be profligate in furnishing all these conveniences and technologies to them without some typical pioneering sacrifices on their own parts; (7) we must be very careful that we do not introduce into a regional economy a great agricultural settlement program which will upset the balance between the agricultural and industrial development of the area; (8) we will probably have to recognize that the Government must offer lenient and long-time credit to many settlers, but that in doing so it must not inadvertently rob the settlers of their own initiative or dampen their zest as real pioneers in building up a new section of the country.

Articles for Reclamationists

BOISE PROJECT, IDAHO. WORK STARTS AT ANDERSON RANCH DAM. Pacific Builder and Engineer, November 1941, pp. 44–46. Preliminary construction under way. Dam site in precipitous granite canyon on South Fork of Boise River, 20 miles northeast of Mountain Home and 7 miles from nearest existing highway. Project comparatively inaccessible, therefore camp construction more extensive than usual—theater, commissary, schoolhouse, residences, bowling alley (all frame) to be completed in December 1941. Diversion tunnel 20 by 1,500 feet to be driven through solid granite. Gives idea of difficulties that will be encountered and methods to be used in surmounting them.

BOULDER CANYON PROJECT, ARIZONA-NEVADA. ADVENTURE ON FORTIFICATION HILL. By Hulbert Burroughs, The Desert Magazine, December 1941, pp. 24–28. Description of adventures on Fortification Hill, about 3 miles from Boulder Dam. Experiences not to be used as guides for other explorers, because of lack of proper preparation; but is an interesting narrative.

BOULDER CANYON PROJECT, ARIZONA-NEVADA. BOULDER TRANSMISSION LINE UTILIZES POURED-IN-PLACE FOUNDATIONS. By K. A. Reeder, Civil Engineering, December 1941, pp. 722–25. Paper originally presented before Soil Mechanics Foundation Division, C. E. Convention in San Diego, Calif. Description of materials and methods used.

CEMENT DISPERSION AND CONCRETE QUALITY. By E. W. Scripture, Jr., Engineering News Record, December 4, 1941, pp. 82–5. "Making cement in concrete mix more effective purpose of dispersing agents . . . clumps of cement separated into individual particles, presenting greater surface for hydration, requiring less water for given consistency. Dispersion equally effective with normal and special portland cements." (Abstract from Contents in Brief.)

CENTRAL VALLEY PROJECT, CALIFORNIA. FRIANT, ABSORPTIVE LINING AT. By Donald S. Walter, Field Engineer, Western Construction News, October 1941, pp. 298–301. Describes form lining and method of use. Results of use compare favorably with laboratory experiments.

CENTRAL VALLEY PROJECT, CALIFORNIA. FRIANT DAM. PART II. By Henry W. Young, Compressed Air Magazine, November 1941, pp. 6777–83. Last installment of material on Friant Dam, first of which appeared in October 1941 issue of same magazine and notice given in January issue of Reclamation Era. Gives description of methods of construction and materials and equipment used. Slush ice-water mixture used to reduce temperature of concrete; also describes method of producing slush ice. Pumicite used with cement ("First" in dam construction). Absorptive form lining used—a Bureau of Reclamation product through experimentation in Denver Office laboratory. (Eight hundred miles of 1-inch pipe to be embedded in concrete carry water to help in cooling.)

CENTRAL VALLEY PROJECT, CALIFORNIA. SHASTA PROJECT HIGHWAY RELOCATION. By F. W. Haselwood, Civil Engineering, November 1941, pp. 641–644. Old "emigrant route" north of Redding, Calif., goes through as rough country as was ever traversed by stagecoach. Alongside of it is present Pacific Highway, U. S. 99, which had to be relocated around lake to be formed back to Shasta Dam. Article shows great contrast between two routes, with problems confronted and solved.

NEWS OF THE MONTH

On the Alert!

ALREADY IN EFFECT when Pearl Harbor was attacked were plans for protecting vitally important Reclamation project structures from sabotage. The attack merely sounded the signal for the alert. At Boulder Dam a company of Military Police had been patrolling the switchyards and outlying facilities for several months supplementing the augmented force of rangers. Visitors were barred from the dam structures and other extraordinary precautions were taken. At Grand Coulee Dam a detachment of the 172d Infantry in training at Camp Lewis supplemented the civilian guard force employed by the Bureau and the contractors. On the All-American Canal and the Yuma project, troops were moved in to be added to the civilian guard service. Prompt steps were taken to strengthen or provide the guard service at important dams and power structures of projects elsewhere in the Pacific Coast States and in the Intermountain States.

Guards on Reclamation structures improve their marksmanship

On the Central Valley project a large force of guards were placed on duty at the site of Shasta Dam and at the Pit River bridges and other structures. Guards were already on duty at Parker Dam where activities were in cooperation with the Metropolitan Water District of Southern California. Elephant Butte Dam and power plant and Caballo Dam of the Rio Grande project in New Mexico had been patrolled for several months, as had also dams and other structures of the Salt River project where the Salt River Valley Water Users Association had built up a protective organization.

Projects operated by water users are the responsibility of local organizations under arrangements the Secretary of the Interior is authorized to make with them.

FIVE ARMED GUARDS maintain 24-hour duty at the Parker Dam project on the Colorado River whose power plant is scheduled to begin generating needed hydro energy for the Southwest this year.

POWER for the second year in succession has featured the $100,000,000 western construction activities of the Bureau of Reclamation, Federal irrigation agency. More vital than ever to national defense in the widening world struggle, huge hydroelectric generators were installed and ordered at an unprecedented rate, according to the annual report of Commissioner Page to Secretary of the Interior Harold L. Ickes. During the fiscal year ending June 30, 1941 four new power plants on Reclamation projects began operations, the installation of additional generating equipment was being rushed in order to double the existing capacity by 1943, one new power project was authorized and a list of 50 potential projects with power possibilities was submitted to the Congress for consideration.

WAR NEEDS for linseed oil will probably increase the acreage on Reclamation projects planted to flax this year. North Dakota farms will profit—flax seed is one of the State's chief crops.

INTERIOR clerks worked on January 1.

INCREASING the facilities for protection of Rye Patch Dam, a contract recently was entered into which will bring electric power to the dam. It will necessitate the construction of a line 2¼ miles long from a trunk transmission line. It will ease, as well, the work of operating and maintaining the dam. Formerly all operating mechanisms were powered with engines fueled with gasoline.

TREATING INJURED WORKMEN is not the only task performed by doctors and nurses of Mason City hospital, the company-operated institution at Grand Coulee Dam. Seven hundred and fifty babies have been born there since the present contractor, Consolidated Builders, Inc., took over its operation in 1938.

Provo's Water a War "Must"

HONG KONG FELL when the water supply gave out—which speaks volumes for Reclamation reservoir construction such as the Provo River (Utah) project which includes a municipal water supply for Salt Lake City. Accordingly, the Bureau is rushing the Salt Lake Aqueduct to completion. Dependent on this new water supply for uninterrupted operation will be a $35,000,000 small arms plant, important copper plants at Magna and Arthur, a $126,000,000 steel plant soon to be underway, an aluminum oxide plant and other war material factories. Indicatory of the importance of the copper plants alone, for example, the Provo Valley mines produce nearly a third of the red war metal now available to the Allied nations. Without the aqueduct and the new water supply a sudden drought would hamstring the war effort of the entire region.

Additionally dependent upon this suddenly vital byproduct of Reclamation irrigation may also be a new military center. The Ninth Army Corps is contemplating centering activities at Salt Lake City, safer from bombing than San Francisco on the coast. If consummated the center would operate all quartermaster activities, communications and transportation of the Pacific coast army from San Diego to Alaska. Thousands of troops would be quartered there, and nearly 50,000 new workmen and families for the war factories.

A FLOODLIGHTING SYSTEM is planned for Laguna Dam (located several miles below Imperial Dam which diverts Colorado River water into the All-American Canal), Laguna, an old dam, diverted the Colorado for the Yuma project.

UNIFORMED armed guards will protect Grand Coulee Dam from sabotage and other destructive acts during the war in addition to a detachment of infantry. The civilian guards were chosen from civil service rolls and will be paid $1,500 per year. Some served as guards at the State penitentiary, others are deputy sheriffs, and two are former Washington State patrolmen. Marshal Wardall, ex-sergeant of the Washington State Patrol, is captain of the force.

ENGINEER Mills E. Bunger has been transferred from project investigations, Phoenix, Ariz., to the Denver office as senior engineer. He will be in charge of investigations on the Bridge Canyon, Hassayampa, Parker-Phoenix aqueduct, Snowflake, Winslow, and Davis (Bullshead) projects in Arizona-Nevada.

Almost 20 Years After

A MUCH SOILED, dog-eared settlement inquiry card printed prior to 1923 when the Bureau of Reclamation was known as the United States Reclamation Service was recently received by the Washington Office of the Bureau of Reclamation. The card apparently had been filled out years ago, but was not mailed. Fresh erasures indicated a change of home address during the years—but none in the writer's heart, which still remained set on a Reclamation home.

GRAND COULEE DAM'S second powerhouse is in full swing because of the urgent need for power for the war effort. Placement of the deck on which 27 large transformers will rest is the initial step toward completing the east shore building which ultimately will house 9 of the world's largest generators, each rated at 108,000 kilowatts and capable of producing enough electricity daily to make 100 tons of aluminum, sufficient to build 6 four-motored bombers or 32 fighter planes.

A PIONEER of engineering activities in the Boise basin as early as 1898 and made superintendent of the Minidoka Reclamation project in Idaho in 1923, E. B. Darlington died at 67 in Santa Monica, Calif., his home since his retirement from the Bureau in 1935.

A "STOOL PIGEON" RODE ALONG when the General Electric Co. recently shipped a load of transformer parts from its factory at Pittsfield, Mass., to Grand Coulee Dam.

The company installed a "shock recorder" on the large 16-wheel railroad tank car carrying the core and coils for an 85-ton transformer as a check to determine if the shipment was handled roughly in transit.

The device draws a graph of car vibration during the entire trip, faithfully recording any careless handling of brakes or throttle, giving the date and time. Because of its tattletale characteristics, railroad crews sometimes call it a "stool pigeon" or a "snake."

The huge tank car, with a gross weight of 312,000 pounds, carries the core and coils in an airtight chamber filled with nitrogen. The gas prevents moisture from entering the windings, dampness being a very undesirable element in things electrical.

AN ILLUSTRATION of the beneficial training received by C C C boys on Reclamation C C C camps: Eight lads from the Orland Reclamation project camp, BR-78, learned enough about survey work to get Bureau jobs on the Central Valley project.

TWO POUNDS OF DIAMONDS costing $50,696 have been bought by the Bureau of Reclamation for core-drilling crews at Grand Coulee Dam. Drilling has been under way since the spring of 1937.

A GIANT BATTERY that would start 16,000 automobiles parked all night in near-zero weather is housed in the Grand Coulee Dam's west powerhouse for emergency in case of power failure. Composed of 120 individual cells and housed in a large concrete room 87 by 28 feet, the big battery is rated at 640 ampere-hours at 250 volts. If its output of 160 kilowatt-hours were used for three 60-watt lamps it would keep them lit for an entire year. The big battery is not expected to be used much. It should last about 40 years. The east powerhouse will have a similar emergency battery.

Grand Coulee's emergency batteries

AS WAR with Japan began, 1,426,987 kilowatts of electrical energy were being generated at plants scattered through the western States administered by the Department of the Interior and principally used for the war effort. Power from Interior plants is supplying the entire aluminum industry in the Pacific Northwest, half the airplane industry of the Pacific Southwest, and serving many other munition plants. In 1936, Japan reported to the Third World Power Conference a total installed capacity of all electric energy of 5,794,000 kilowatts.

A FORWARD-LOOKING STEP toward comprehensive, cooperative planning in the development of the Colorado River Basin has been taken by the Bureau of Reclamation and the National Park Service. The two bureaus have tentatively agreed that the Bureau of Reclamation turn over to the National Park Service for investigation of possible recreational aspects in the Colorado River Valley 5 percent of all revenues from Boulder Dam made available to the Colorado River development fund. This is expected to amount to about $75,000 over a period of 3 or 4 years, an amount large enough to lay the foundation for consideration of the recreational side of all irrigation, power and municipal water supply multiple-purpose projects undertaken in the Colorado River Basin by the Bureau of Reclamation.

CALIFORNIA'S new lake being formed by Friant Dam in the foothills of the Sierra Nevada northeast of Fresno has been officially named Millerton Lake. The reservoir was given the name because it will completely submerge the townsite of Millerton, the first county seat of Fresno County, and Fort Miller, the first United States military post established for the protection of early settlers from Indian depredations. The lake has reached 6½ miles up the San Joaquin River and a depth of 70 feet just behind the dam. Water is backed up just beyond Fine Gold Creek which enters the reservoir from the Madera County side.

TO PREVENT ice from collecting against the Grand Coulee Dam in the winter, the Bureau of Reclamation is installing a unique ice-prevention system that will release an endless curtain of tiny air bubbles through the water against the upstream face. A thousand small nozzles, attached to pipelines situated below the surface of the large reservoir and fed by four compressors, each will blow from 2 to 3 cubic feet of air per minute into the water to keep it constantly agitated. This will prevent ice from forming near the trashracks, the debris-collecting structures protecting the entrances to the tubes which will carry water through the spillway, to the turbine-generators in the powerhouse, and to pumps of the future irrigation pumping station. The trashracks, bay windowlike structures, consisting of steel racks or grids held in place by concrete columns spaced in a semicircle, will prevent logs and other large material from passing through the various tubes in the concrete.

WELDING classes at the Yuma Reclamation project in Arizona have led to war jobs for students. Several who have attended the sessions are now employed in war industry on the west coast. The classes are held four times weekly, each session consisting of 3¾ hours of training.

AN ADDITIONAL $2,500,000 appropriation has been approved by the Congress for Anderson Ranch Dam near Boise, Idaho. The 1942 appropriation for the Department of the Interior allotted the project $1,500,000. Cost of the dam and power plant with features as now planned is estimated at $13,000,000. It is believed that aggressive work can complete the job a year to 18 months sooner than the scheduled date, August 1946. The dam will be earthfill, 330 feet high, 1,350 feet long. It will contain 8,500,000 cubic yards of material and create a reservoir with a capacity of 500,000 acre-feet. The power plant will have a capacity of 30,000 kilowatts. Materials, machinery, and supplies for the plant have been assigned a priority of A3.

Importance to Reclamation of

Mineral Production

By HERMAN STABLER, *Chief Engineer, Geological Survey*

IN 1902 EFFORTS to secure irrigation of the arid lands of the West through private and State initiative having approached an economic limit, Congress made provision for a Federal agency to examine, survey, and construct irrigation works required to reclaim the public lands.

This gigantic enterprise was to be financed by receipts from the sale of public lands which, for the fiscal year 1901, amounted to a little more than 3 million dollars and now has dwindled to an insignificant sum. Meantime the scope of the work was enlarged and additional financial support became necessary.

One of the most effective means of obtaining additional funds for reclamation was the insertion in the mineral leasing law of February 25, 1920, of a provision dedicating to the Reclamation fund 52½ percent of the revenue from mineral leases, which provided a subvention for public-land agriculture from the mineral resources of the public domain.

One of the most effective means of maintaining mineral-lease revenue at a high level has been through operations of the Geological Survey supported by an appropriation, currently $315,000 per annum, for supervision of mineral-lease operations in order to avoid waste, secure adequate recovery of mineral deposits exploited, obtain a proper revenue, and assure conditions of operation favorable to the health and safety of workmen.

The revenue obtained under the mineral leasing law has amounted to more than $120,000,000 and currently averages 6 to 7 million dollars a year. The returns of the Reclamation fund from this source alone are greater, though of the same order of magnitude, than returns from sales of public lands when the Reclamation Act was passed.

There can be no doubt that mineral-lease operations, supervised or otherwise, would return substantial revenue to the Government. On the basis of much cumulative evidence, however, it is estimated that such revenue would be reduced by at least 20 percent if supervisory work such as is done by the Geological Survey were not performed. Every water user on a Reclamation project has, therefore, a material interest in what the Survey does that serves to maintain or augment the revenue accruing under mineral leases.

Mineral Survey First Duty

The first mineral-lease duty of the Geological Survey, assigned to it by Congress in 1879, is mineral classification of the public lands. This involves field surveys and investigations, the final product of which is an inventory of the mineral resources of lands owned by the United States and the initiation of formal orders of withdrawal or classification or other actions necessary to retain such resources in Federal ownership subject to lease. This work is done in furtherance of a long-standing but frequently attacked governmental policy. Those who urge turning federally owned mineral resources over to the States propose in effect to eliminate the chief source of accretions to the Reclamation fund.

The second mineral-lease duty of the Survey is to promote an orderly leasing program—to see that lands that should be developed are offered for lease and that leases are not issued if they will interfere with appropriate development of the mineral resources or of the region that contains them.

By and large promotion is unnecessary, unsolicited applications for lease providing for more production than the market demand warrants. In the case of oil and gas, however, constant watch must be kept over operations in public-land areas to make sure that lands threatened with subsurface drainage are promptly offered for lease. In the case of coal and some other minerals effort is made to provide for a reasonable number of competitive operations in a given area without encouraging competition so keen as to necessitate high-grading or other wasteful operations or the neglect of important safety measures in order to make a temporary profit with consequent risk of fire, explosion, or other disaster.

The third mineral-lease duty of the Survey is to recommend for mineral-lease applications and offerings appropriate lease terms as to acreage, required investment, minimum required production, royalty, and other technical matters. Such terms must be reasonable if lease operations are to be successful, and lease operations must be successful if they are to produce revenue. On the other hand, if royalties are too low, or if the required investment is too small to support an operation of the scale contemplated, or if the required production is not commensurate with area of land and volume of deposits leased, the Reclamation fund is bound to suffer. Effort is made to keep in touch with conditions throughout public-land areas and to recommend lease terms reasonable both to lessor and lessee under the particular conditions of the region in which the leased land is situated.

A fourth mineral-lease duty of the Survey is to inspect mining and oil and gas operations in the field to see that they are being conducted in a manner such as to safeguard properly the health and lives of workmen, to assure adequate recovery of mineral, to provide for future development, and otherwise to secure the greatest ultimate practicable recovery of minerals. It is in the performance of this duty, in cooperation with lessees, that the Geological Survey performs services most directly beneficial to the Reclamation fund.

Some lessees have their own engineering staffs and are competent to plan development of their properties as well as to conduct operations of the best and most adequate type. A much greater number are struggling along with inadequate financing and inadequate knowledge of the technical phases of the business in which they are engaged. In either case the lessee is interested primarily in the profits to be obtained. The weaker his financial condition the more

does his interest lie in immediate profits rather than in the long-range probabilities. It is not surprising, therefore, to find that lessees overlook many measures that might be taken to increase ultimate production of minerals and long-time revenue therefrom, particularly if such additional production can be obtained only at increased cost of operation even though such increase is slight.

Secretary of the Interior Harold L. Ickes has said, "Knowledge of their existence in quantity, quality, and location followed by * * * orderly exploitation of mineral deposits, without waste, will insure a sound and permanent welfare of the citizens of the United States"; and again, "The principle underlying true conservation is the protection, upbuilding, and prudent use of our natural resources for the greatest good of the greatest number of people." These principles guide the Geological Survey in its supervision of mineral-lease operations.

Waste of mineral resources, once they are brought to the surface of the ground, is against the profit instinct of the producer and is generally avoided except in the case of blowing gas to the air. About 3,000 cubic feet of ordinary natural gas has as much value for fuel purposes as a barrel of oil. Unless there is a market for the gas produced with oil there will occur tremendous waste of material that might otherwise be saved for future market and to provide future returns of the Reclamation fund. More serious than such surface waste is the unseen underground waste brought about by loss of pressure in the productive sand. As pressure declines, the live oil loses its energy until at last unrecoverable dead oil remains. Maintenance of reservoir energy until a practicable maximum of oil has been produced is most effective conservation.

In the field of mining, underground waste may result from fire or explosion that may wreck a mine and render its workable deposits unrecoverable. Similar wastes occur from poor planning and development of coal mines which may result in "squeezing" and premature caving that prevent subsequent operations in the area. As long as coal is abundant such loss does not seem so serious, but in time it will not only spell higher prices to consumers but also dwindling returns to the Reclamation fund.

The conservation work of the Geological Survey in mineral-lease supervision is not spectacular but results in savings that, in the aggregate, reach rather impressive totals. A few recent accomplishments, all made possible through cooperative action of operators, are given in the following paragraphs.

A few months ago Survey engineers devised and operators put into practice a new method of coal recovery in mechanized mines that increased the extraction of coal from about 35 percent to more than 85 percent of that in the mine. As a result, royalties will be increased in the amount of $1,000 to $2,500 per acre.

In the past few years a campaign of education on the benefits of unit operation of oil fields has been conducted, and more than 100 fields are now operated wholly or in part under approved cooperative or unit plans of development and operation. Somewhat more than half the revenue derived from public-land oil and gas leases comes from fields so operated. Although it is not possible to determine accurately the benefits to the Reclamation fund from this effort, it is conservatively estimated to be at least half a million dollars a year.

As an example of savings through reduction of gas-oil ratio, mention is made of repairs to three wells affected by a single operator recently at the instance of the Survey resulting in a reduction of $1,100 a day in value of gas theretofore blown to the air for lack of current market, but which has been retained underground and undoubtedly will be needed and marketed in the future. Such instances are of common occurrence.

A fifth mineral-lease duty performed by the Geological Survey—one of special interest to users of the Reclamation fund—is that of determining the amount and value of production under lease as a basis for computing the royalty liability of lessees. Some mining leases provide for a flat royalty in cents per ton. For these the task is relatively simple. Mine weights, sales weights, railroad weights, and other indices to amount of production are verified, investigation is made of the possibility of waste of mined material without sale, and finally measurements in the mine are made to obtain a final check of extraction of ore against sales. Other mining leases provide for royalty on the gross value of production at point of shipment. For such leases there is for determination not only the tonnage shipped, which may involve partial processing and packing with appropriate allowances, but also a unit price or value at the point of shipment, from which the starting point for determination of value ordinarily is a delivery price many miles distant. From this must be deducted transportation costs and sometimes other allowances. Shipment may be partly by rail, partly by water, and partly by truck, so that costs of lighterage, transshipment, and the like may enter into the picture. Unit price at point of shipment may therefore be different for each consignment of material. As a further check on current determination an occasional complete audit of operations and sales is undertaken.

In the case of oil and gas leases there are for determination the quantity, quality, and fair unit price of oil, gas, natural gasoline, and lately of butane, iso-butane, and other liquid hydrocarbons derived from processed gas. The quantity of oil is customarily determined by measurement in tanks. The strapping of tanks is checked, spot checking of runs from tanks, including temperature, gravity, and percent of impurities, as well as volume, is undertaken, and all "run tickets" or records of shipment are recalculated and final assurance had as to quantity and quality. Other liquid hydrocarbons are handled much in the same manner as oil except that where a processing plant handles wet gas from several sources the volume of plant output, after allowance for cost of processing, is prorated back to the several sources on the basis of quantity and quality of wet gas derived from each of those sources. Quantity of gas is determined by orifice meters, and the meter charts are checked by the Survey.

In the matter of unit price, it is the general rule to accept the price received by the lessee unless there is reason to believe that it does not reflect fair value. Minimum acceptable prices for gas and natural gasoline have been established for general application. For oil, a normal acceptable minimum price is the price at which a majority of the oil of similar quality from the field is sold. Occasionally there is apparent discrimination against oil from some field in a controlled market and it becomes necessary to fix a minimum acceptable price for oil from such a field by relation to prices current in other fields or regions.

All these activities, somewhat inadequately pursued because of limited funds, are undertaken to assure the Reclamation fund, the public-land States, and the United States Treasury of a fair return from mineral deposits on the public lands.

Potash Deposits Discovered

A rather dramatic mineral-lease development of recent years in which the Geological Survey has played a prominent part is the discovery, leasing, and development of extensive deposits of potash on the public domain, a matter of interest to every water user because it served to augment the Reclamation fund and also reduce the price he has to pay for potash fertilizers. During the First World War the price of potash, almost entirely imported from Europe, soared to unconscionable heights. During the present Great War the price of potash has remained less than in 1913 because five plants produce largely from public lands in California and New Mexico all the potash needed in the United States. The revenue from potash leases has risen steadily in the past decade from a few thousand dollars a year to more than $301,000 in the fiscal year 1941.

Revenues from oil and gas are likely to decrease in the not distant future; revenues from coal should remain steady with a tendency to increase for many years to come; and revenues from other minerals subject to lease, including chiefly potash, sodium, and phosphate, should gradually increase, vast deposits of phosphate now being virtually untouched. Extension of the leasing principle to still other minerals, as recommended by Secretary Ickes, would also serve to augment leasing revenue and maintain the Reclamation fund.

New and Pending Water Legislation

A sober discussion of "authorities"

By JUDGE CLIFFORD H. STONE

Director, Colorado Water Conservation Board, . . . in which he expresses a western view which all who are interested in the subject will be glad to have. Originally prepared for the 1941 meeting of the National Reclamation Association.

A FULL TREATMENT of the subject New and Pending Water Legislation would require more space than can be assigned. It involves the approach to many problems of water utilization and conservation by Federal and State governments. A mere listing of laws which have been passed or of those which are proposed and a recital of their salient provisions would serve no useful purpose here.

The proposed legislation that would create Federal authorities to direct, supervise, and control water development and conservation of natural resources in recent months has aroused the greatest interest. Although not yet considered by any congressional committee, these proposals have invoked heated discussion. The passage of such legislation will affect vitally the future welfare of the people of the West where vast natural resources—land, water, mineral, and recreation, with their related potential industrial advancement—remain largely undeveloped. Policies involved strike at the very roots of the economic and social well-being of a people who live and must carve out their livelihood in a land where a river and its proper utilization and control are necessities of agricultural development. Principles involved concern the recognition of respective powers of a dual (Federal and State) form of government.

Although having social, economic, and political aspects in the broad sense, these legislative proposals are not in any way related to partisan politics. But it is proper that the members of an organization such as the National Reclamation Association, dealing with problems of water and land development, should be concerned and voice their views.

It should be understood at the outset that in this discussion, the question of private versus public power it not involved. We propose to approach the problem from the point of view of what is necessary and advisable, consistent with a reasonable national interest, to preserve, protect, and develop water and land resources of the arid and semiarid West.

It should be recognized, too, that for many years agencies of the Government, such as the Bureau of Reclamation, have constructed federally-financed projects with hydroelectric power production as a function, that both private and public bodies have purchased and distributed power so produced; that under the present policy and the Reclamation law of 1939, public bodies have preferential call upon this electrical energy; and that under the present policy and in the case of all recent Reclamation projects, the Government retains control of the power. It should be recognized further that the proceeds therefrom have made possible many highly desirable irrigation structures which otherwise would not be feasible.

Advocates of Authority legislation fail to recognize these facts. They present their proposition as if there were not existent an expanding and tested program of water development providing irrigation, flood control, and cheap power. They offer Regional Authorities as the only means by which these beneficent results may be attained. They propose a new plan, founded on a different policy, and designed to replace, if not in theory, in practice, existing agencies of Government long engaged in this field of endeavor. They sponsor legislation fraught with grave questions of centralized Federal control, of circumvented congressional supervision and of doubtful methods for incurring Federal obligations. They fail to visualize the possibility of coordinating existing agencies and enacting remedial legislation necessary to attain an adequate program for the conservation and development of land and water resources.

Expand Existing Agencies

Referring to the vast and largely undeveloped areas in the 17 Reclamation States, these principles should be recognized, namely:

1. That the value and extent of agricultural land is dependent upon the availability of a water supply from a surface or subsurface source; and that, in the best interest of western economy, prior use of these waters should be dedicated to domestic and irrigation purposes.

2. That the right to use this water constitutes a property right upheld and protected under state constitutions and statutes heretofore recognized by the Federal courts; that on the basis of these property rights, western agriculture, with all its incidental industrial development, has been built; and that any procedure which removes the judicial determination of these rights from the State courts tends to weaken local autonomy.

3. That recognizing the highest use of water from growing crops except, of course, its use for domestic consumption, multiple-use Reclamation projects should be so designed and operated that power production shall at all times be subservient to the need of irrigation; and that in the allocation of repayable costs, power should bear its just and reasonable share, so as to reduce as far as possible the cost to the farmer.

4. That, in order to obtain a maximum basin-wide development and a workable adjustment of conflicting claims and to prevent the intervention of an overriding Federal authority which would control such development and dictate such adjustment, the freedom to compact between States must be fostered and maintained. The States must encourage the amicable adjustment of interstate and major intrastate controversies.

5. That these water resources cannot be reduced to beneficial use without due regard for the reasonable national interest; but that such national interest must always be appraised and considered in just relation to local and State interests.

These principles, in my opinion, must be recognized in western reclamation. Any legislative proposal which threatens them, or any one of them, is inimical to the present and future development of the West.

May we briefly allude to proposed Authority bills to determine whether, and in what way, these principles are violated. In doing this, we refer to strictly regional Authority legislation, such as the Arkansas Valley, the Dakota, and the two Rankin omnibus Authority proposals. Congressman Rankin of Mississippi has introduced two bills which propose covering the entire Nation with these regional Authorities.

This class of bills springs from the school of thought that appears to feel it necessary to have independent Authorities with extensive powers in the planning, construction, and operation of projects, and of more concern to us, with extensive power over the initiation and use of waters within the river basins in which they are to operate. These Authorities are to be governed by one or more persons, appointed by the President, with wide latitude for unreviewable action, and with no adequate provision for keeping the policies of the several independent Authorities consistent.

One Type Not Objectionable

There is another type of Authority bill which, as we see it, is markedly different. In this type of bill, if we correctly read its scope, the intent is only to deal with the problem of marketing power that will become available in the operation of certain multiple-purpose projects—projects wherein the development of water for primary reclamation purposes will proceed under existing law, and where the Authority will not, in any sense, dip into the matter of control and use of water. Of

the latter type appears to be the proposed Columbia Power Authority bill introduced by Congressman Hill. While this type of bill may be subject to some criticism of the kind we level at the other "Authority" bills, if my interpretation of the scope of the Hill bill is correct, its defects may lend themselves to correction by amendments. This is a matter for further serious study and thought. For the moment, let us direct our attention to the more objectionable Authority bills.

The violation of reclamation principles, above enumerated, by these Authority legislative proposals may be summarized as follows:

1. The motivating force back of them is cheap power. The production of hydroelectric energy is placed in the foreground as the first objective of water development. The planning is in the hands of officials who, because of financial requirements to sustain the Authority and the spirit and general purposes of the law would provide for ultimate development of a basin from strictly the power point of view. The present-day appreciation of the desirability of cheap and available power and the demands for national defense are arrayed by their proponents in support of Authority legislation. No one here is questioning the desirability of widespread cheap power; and all subscribe to the necessity of national defense.

2. But in the frenzy to secure these things, we should not jeopardize the future of western irrigated agriculture. The long-time economy of the region must not be disregarded. Agriculture supplies a large part of the power markets and contributes in a large measure to industrial development. Agriculture, livestock growing, and mining are dependent upon these water resources; but power can be economically produced, under modern methods, from coal and oil, of which there is an abundance in most sections of the West.

3. The constitutional basis for the creation of these Authorities lies in the promotion and protection of navigation, flood control, power production, and the national welfare and defense. By decisions of the United States Supreme Court rendered within the past year, flood control and electric-power production have been held to be within the Commerce Clause of the Federal Constitution. Under the cloak of control and use of water for these Federal functions, the Authority is invested with power to control the appropriation, use, and distribution of water for all purposes, including irrigation. The control of the appropriation, use, and distribution of water for irrigation, domestic, and manufacturing purposes under State laws is effectively divested. Specific language in the Authority bills to this effect is not there and not necessary. Likewise, specific language inserted in the legislation, by way of amendments, as proposed by some western men, to reserve to the States the control of these waters for irrigation and other beneficial purposes would be unavailing and an idle gesture, because to do so would be to defeat the very purpose for which the law was created, annul the authority reposed in the designated officials, and deny the constitutional basis under which such Authorities must operate. Legally, you cannot have in this respect a hybrid thing. The word "Authority" in these bills is no idle term; it is pungent with meaning. By a stroke of the pen, through administrative procedure set up in the proposed acts, the conflict between State and Federal laws, in the administration of the use of water, is effectually determined; and it will not be in favor of the States.

Cover Entire Basins

These Regional Authorities cover entire river basins; and it must be so if they are to function. In many of these western river basins, such as the Arkansas, conditions as to climate and requirements for irrigation, flood control, and power production differ greatly. It has been proposed by some that these bills be amended to divide the basin, eliminating the control of the Authority in the upper areas where irrigation is practiced. This would not cure the situation nor would it be a practicable solution. An Authority astride the lower section of the river would have supreme control of the waters thereof whether within or originating without the geographical sphere of its activity. Furthermore, if an Authority were once set up in part of a river basin, it would only be a matter of time until its territory would be extended to cover the entire basin.

Under the Arkansas Valley Authority and Rankin bills, the Federal court is in terms and by recognized procedural practice vested with exclusive jurisdiction to determine questions affecting rights to the use of water. The last Rankin bill provides:

"The District Court of the United States for the judicial district in which the principal office of the Authority is located . . . shall have exclusive jurisdiction of all proceedings at law or in equity against such Authority . . . or any officer of such Authority, in which there is drawn in question the validity of this act or any other law of the United States, or the validity of any act or conduct of such Authority . . . done pursuant to or under color of this act or any such other law; and no other court of the United States, and no court of any State, shall have jurisdiction of any such cause now pending or hereafter commenced without the express consent of such Authority . . ."

This bill also specifies an exclusive remedy providing that no temporary or permanent injunction shall be issued except upon the filing of a bond sufficient in amount to recompense

"the persons enjoined, and the Authority, the United States, any intervener, and any person or agency damaged, for any and all loss, expense and damage which may be caused or contributed to by the issuance or continuance of any such injunction."

This provision is so stringent as to costs, expenses, and damages covering all persons involved that any citizen would hesitate, no matter what he believed his rights to be, before seeking by court action to enjoin the threatened acts of the Authority.

3. Under the A. V. A., Dakota, and the Rankin Omnibus Authority proposals, interstate compacts involving the waters within the region under an Authority

"shall not become effective or binding upon the States party thereto unless and until it shall have been submitted to and approved by the Authority . . ."

The last Rankin bill also provides that such approval shall be granted

"if it finds such . . . compact and the projects and activities contemplated thereby to be feasible, practicable and appropriate to and consistent with the policies and purposes of this act."

Accordingly, not only must the Authority approve interstate compacts, but such approval cannot in any event be secured unless the compacts are in compliance with the policies and purposes of the Authority legislation.

4. By the terms of the A. V. A. and the Dakota proposals, the Authority could and undoubtedly would supplant existing agencies, including the Bureau of Reclamation, in the planning, construction, and operation of water projects. By the terms of the last Rankin bill, the Authority would coordinate and integrate projects, activities, and regional developments and study and survey the projects and activities, within the region of such Authority, of the departments of the United States relating to navigation, the control of floods, the development of hydroelectric power, and the reclamation of the public lands, for the conservation and prudent husbandry of the water, power, soil, mineral, and forest resources of the Nation. This Rankin bill also provides that whenever pursuant to the act

"or any other act of the Congress, any project or activity is entrusted to an Authority, such Authority shall construct, operate, and carry out such project or activity. . . ."

Demands Arise From Needs

It can be seen that, although the last omnibus Authority proposal does not go as far as the provision of the A. V. A. in this regard, yet by its enactment existing agencies, including the Bureau of Reclamation, would be subjected to the Authority, in the planning, investigating, and surveying of irrigation projects; and in addition a new construction agency for such projects would be placed in the field. Under the domination of such an Authority which would make the project recommendations to the President and Congress, it is easy to conclude that the Bureau of Reclamation would become relegated to a limited sphere of activity.

Moreover, it is too clear for verbal demonstration here that, if projects are to be undertaken by the authorities, they would be undertaken in disregard of many time-tested policies that have been incorporated as requirements in the basic Federal Reclamation laws. No good can come to the irrigation program of tomorrow, half Authority borne, half Reclamation sponsored.

Conditions Demand Action

Adherents to the theories of planned economy and strong central control of natural resources and those who think of water resources largely in terms of hydroelectric production, have sponsored the Rankin omnibus bill, the Arkansas, and the Dakota Authority legislation. But the problem is not limited to theories of economic development. The incentive for this legislation has in a large measure arisen out of conditions which demand some form of action.

These are:

1. The existence of large areas in the United States where no present agency of the Government can adequately function in the field of water development. Arkansas, Louisiana, and Mississippi in particular are not included in the area in which the Bureau of Reclamation can function.

2. Although there is marked progress evident in the coordination of the activities of Federal bureaus and agencies engaged in flood control, water development, and conservation, there is general recognition that in the interest of economy and the realization of maximum benefits from development of our water resources, there must be evolved some procedure for more effective coordination in the planning, construction, and operation of such projects; and that conflicts in the plans and operation within river basins, evident in many cases in the past, must be avoided.

3. The existence of power facilities on large multiple-use projects from which large blocks of power will be available for commercial sale. This condition has arisen because, to serve the interests of national and local economy, to secure maximum use of water for all beneficial purposes, and, to make some irrigation projects feasible for authorization, it has been desirable to provide for such additional power capacity as a means of reducing the share of project costs that would otherwise have to be borne by the water users.

A Solution Is Suggested

It cannot be too forcefully emphasized that, if you oppose these Authority proposals, you cannot hope for success in your opposition by a mere negative position. It is evident that there is not authority for all phases of the water program.

The solution is indicated by the immediate problems. It will not be settled by theories on which there is an apparent difference of opinion. May the solution be suggested here, not in detail, because time does not permit, but in general outline. It is this:

1. That all Federal legislation relating to the control, regulation, and utilization of water in interstate river basins recognize fully the principle of equitable cooperation between Federal and State Governments, each operating within its constitutional limitations.

2. That the Reclamation Act of 1902, as amended, and as supplemented by the Reclamation Act of 1939, be further amended, to the end that the Bureau of Reclamation may function, in accordance with the provisions of these basic acts, outside of the area to which its activities are now restricted.

3. That appropriate steps be taken by legislation, or otherwise, for the purpose of coordinating more effectively the activities of existing Federal agencies engaged in investigating, constructing and operating projects for the development and utilization of the water resources of the river basins of the United States.

4. That all Federal legislation relating to the control, regulation and utilization of water in the arid and semiarid West recognize fully the principle that the highest use shall be for domestic consumption and for growing crops; that multiple use reclamation projects should be so designed and operated that power production shall at all times be subservient to the needs of irrigation; and that in the allocation of repayable costs the twin problem of having power bear an appropriate share of these costs and of keeping the water users' obligations within their ability to pay may be met; and that, subject to this principle, the development in every river basin be so adjusted and coordinated as to obtain the maximum benefits for all purposes.

5. That legislation be enacted, or present statutes be amended, providing for an administrative procedure for the disposal and transmission of hydroelectric power made available by Federal multiple-use reclamation projects, bearing in mind that reclamation is primarily in aid of irrigation.

This plan is supported by what has already been said. A word should be added. The proposals here made with respect to the expansion of the geographical sphere of operation do not expand or alter in any respect the functional phase of the activities of that Bureau. They are suggested as one of the means of meeting a need which has been at least partially responsible for the Authority bills. Let us not destroy reclamation, as we know it today, by being unwilling to extend its benefits to States outside the present reclamation area where a like need for reclamation exists. That is not a departure from the policy of the past. Other States have been added by congressional enactment to the original reclamation area. It should be borne in mind that of the approximately 102 million dollars made available to reclamation projects by the last appropriation bill, only about 8 million dollars came from the reclamation revolving fund. Any legislation to effectuate the proposal here made should reserve the proceeds of the present revolving fund to the group of States that created it.

As to the proposal respecting hydroelectric energy, it should be noted that it only covers power produced by multiple-purpose reclamation projects; and that it only refers to the legislation establishment of an administrative procedure. It recognizes that the question of power is involved in the problem and makes no attempt to suggest the details.

May it be emphasized that western irrigation leaders should not become embroiled in many of the highly controversial issues involved in power authorities; but that, insofar as additional legislative authority is needed to meet problems not being adequately met and thus defeat the Authority proposals discussed, may it be urged that in the attempt to work out the solution, we continue to confer, not only among the representatives of States but also with bureaus and agencies of the Government dealing with the development and conservation of water resources. But that in so doing, we steadfastly maintain the principles of reclamation herein set out.

MULTIPLE-PURPOSE Palisades Dam project in Idaho has been found feasible and the report transmitted to the Congress.

The Bureau of the Budget authorized the transmittal of the report to the Congress but it informed the Secretary that no estimate for construction would be submitted during the current emergency unless it is demonstrated that national defense requires it. A further limitation imposed by the Bureau of the Budget was that no request for construction funds would be submitted "until local interests have given satisfactory assurances to the Secretary of the Interior that they will eliminate the wasteful use of water in the area to be affected by the project."

The proposed project calls for the construction of a 260-foot dam and 30,000-kilowatt hydroelectric power plant. The dam will create a large reservoir on the south fork of the Snake River near the Wyoming State line.

Severe water shortage with constantly heavy crop losses would be alleviated in the Snake River valley with the new supplemental water supply. The reservoir will also reduce damage suffered from river floods, estimated at more than $400,000 annually.

MORE than 3,800,000 acres now inadequately irrigated will obtain supplemental water supplies from Reclamation projects now under construction.

SEVENTEEN projects in 11 Western States combine irrigation and water power.

IN 1940 a total of 3,316,030 acres were actually irrigated on Reclamation projects.

We Build a
COMMUNITY HALL

By CLARENCE NICCUM

Mr. Niccum, of Cow Hollow, is "The Happy Farmer" who writes regularly about his new community and its life for the Nyssa (Oreg.) Gate City Journal.

TWENTY-TWO FARMERS united together and assessed themselves $5 apiece to start a community hall that in less than 9 months had close to $600 worth of material in it without any other assessments. All the labor was donated by the people of the local community except the electrical work.

Cow Hollow is a little, sort of isolated, shoestring valley. It is a part of the large 100,000-acre Owyhee Irrigation District reclaimed by Uncle Sam's Reclamation Service from eastern Oregon's part of our great desert. Cow Hollow is a break in the hills with a small valley in the bottom. Most of the side walls are not too steep for irrigation, especially the south side, although it is pretty steep. There are 18 small farms in the Hollow. All but two of them are homesteads.

Community Hall, Cow Hollow

Years ago there was an attempt to dry-farm this country. Most of the best land was homesteaded but only one farm in Cow Hollow got in that class. The Reclamation Service's idea was to cut all this land into small one-man sized farms to give a small farm each to many and not large ranches to a few. These Cow Hollow farms range from 70 irrigable acres, the largest, to 23, the smallest. In diversified farming as we have here, 40 acres is more than any man can handle without some help.

When we came in here we were most of us renters that had never had a home of our own and wanted to make us a home in this wilderness of sagebrush. At first we had no roads, just a trail and a very rough one. We all built our houses close to this one trail up the center of the Hollow. Our farms lay back from the center of the Hollow, up on the hillsides.

The near end of the Hollow is 10 miles and the other 15 miles from town and a bus takes our kiddies to town school. We all built small homesteader shacks for to begin with and it very soon became well realized that we needed some place to sort of get together once in a while. Had we even had a local schoolhouse would have sufficed.

All kinds of talk and speculation as to what we could make and use for a place to get together were discussed. Some suggested a brush arbor. That would be good only about four months of the year. Others suggested building a floor out here in the spring and giving dances on it in hopes of raising enough money to house it in in the fall.

Finally one fine morning early in February 1941, after most of us had been here over three years, Doc Raffington, a past-60-years-old veteran of pioneer days in Oklahoma, fixed up a promissory note promising to pay $5 toward the building of a community hall for this community.

Doc took his note at first to Nyssa, our local town, and got about $150 signed up the first day. Then he went to the farmers of the local community. Most all the farmers in the Hollow and a few near by farmers signed up.

Everybody's Business Nobody's

Then began the job of putting up the building itself. At first we planned to make a small building at as low a cost as possible. Roy Rookstool had given us 6 acres of hillside land that was above his irrigation ditch but could be watered from a neighbor's ditch.

We started to dig into the ground on one side and level out the other for the foundation for the hall. We soon found that everybody's business is nobody's business. A few thought we should dig down a ways so as to give us room to get under there to dig out a basement later. The digging was good and the help plentiful so we went on down so as to extend the walls clear down.

The Reclamation Service through the CCC boys hauled our gravel for us and loaned us a mixer for to mix our concrete.

None of our members were real carpenters

See COMMUNITY HALL, *page 48*

A recitation, Cow Hollow, Thanksgiving. *Below:* Adult refreshment table, Thanksgiving

Thanksgiving get-together, Cow Hollow Community Hall

Laying Salt Lake Aqueduct

By J. C. ALLEN, *Senior Engineering Draftsman*

An Exceptionally Watertight Concrete Conduit, Testing Far Above Specified Water Loss Allowance, Takes Shape in Utah.

THE SALT LAKE AQUEDUCT now under construction in Utah by the Bureau of Reclamation to provide domestic and industrial water to Salt Lake City has been tested and found exceptionally well designed and constructed.

The long conduit is one of the features of the multiple-purpose Provo River Reclamation project, whose chief purpose is a supplemental supply of irrigation water for 100,000 acres of intensively cultivated farmland.

About 40 miles long, stretching from the recently completed Deer Creek Dam on the Provo River to Salt Lake City, the pipe line is now about one-third complete. Nine miles of pipe and structures and two long tunnels have been finished. The Olmstead tunnel—3,600 feet long—was completed in November 1939, and the 3-mile Alpine-Draper tunnel in November 1941.

Tests of the completed portion for leakage disclosed a high density of concrete and an excellent pipe joint. Three 24-hour tests of the 9 miles of line disclosed an average loss of 235 gallons per mile in 24 hours, hardly more than could be absorbed by the concrete. Further tests by sections, between vents, were conducted to determine if any appreciably higher losses could be noted in the separate reaches. The maximum loss in any one section occurred in the upstream reach of 1.7 miles, where a loss of 500 gallons per mile was measured in the same time period. The specifications allow a loss up to 3,500 gallons per mile over a 24-hour period. In view of the fact that the hydraulic head on this line ranges from zero to 125 feet, the aqueduct can be regarded as being exceptionally watertight. The line extends along the Bonneville terrace from the mouth of Provo Canyon to American Fork Creek. A roadway was benched out along the entire length of line wide enough to accommodate excavation and laying equipment and to provide storage space for the pipe units. Where the center line cut was greater than 10 feet, benching operations reduced the final trenching to a depth of 10 feet with a width of trench of 10 feet. A 2½-cubic-yard dragline excavated the trench, the line grading being done by hand.

Construction of the line required an aggregate processing plant near American Fork Canyon and a pipe-manufacturing plant at Pleasant Grove. They were built by the contractor, the Utah Concrete Pipe Co. of Salt Lake City. The plant consisted of a warehouse, where reinforcement cages were fabricated, a batching and mixing plant with overhead silos for aggregate and cement, a boiler plant to manufacture steam for curing, and a casting platform. From the casting platform 10 pipe units could be manufactured daily and steam cured in place for three days. A 2½-cubic-yard capacity dragline crane was employed to handle the reinforcement cages, forms, curing boxes, and finished pipe.

Briefly the pipe manufacturing consisted of placing cages and forms on the casting pallets, after which the concrete was pumped from the mixing plant and deposited evenly in the forms by hand. Electric vibrators attached to vertical rails on the steel forms could be raised as the concrete was deposited. After all concrete was placed a wooden curing box was lowered over the pipe, steam hoses were connected, and the pipe was cured for three days at temperatures ranging from 90° to 130° F. Curing was interrupted temporarily after about 18 hours to remove the forms.

20-Foot Concrete Pipe Sections Made at the Site

The 20-foot lengths which the contractor elected to manufacture with a 69-inch inside diameter and 7½-inch wall thickness weighed approximately a ton per foot. The finished unit was removed from its pallet and hauled to the line, weather permitting, or stored in the yard.

A low-bedded, multiwheeled, semitrailer was used to haul pipe to the line. Two men operated the unit, loading and unloading a 20-ton pipe with the aid of a power-driven winch.

Following hydrostatic tests on the first units of pipe manufactured in the winter of 1939–40, a revision in pipe joint was found desirable and after careful study a bell and spigot joint, employing a rubber gasket, was designed to replace the original precast collar.

A major problem encountered and overcome in the new pipe joint was a tendency of the bell ends of the pipe to crack due to compression exerted by the rubber gasket when the bell and spigot were forced into contact. Careful measurements disclosed slight variations in cross-sectional area of the rubber gaskets. Since rubber can be deformed but not compressed, any appreciable change in the recess volume on the spigot had to be noted and a gasket selected which would best fill this particular recess. The method devised to make proper selections was to submerge each gasket in water, measure the displacement by means of a calibrated glass tube, then attach a tag noting its volume. By measuring the circumference of a gasket recess and recording its variation from the design standard, the proper gasket volume could be determined and a gasket selected to meet the requirements.

To expedite manufacturing and laying, all curves, horizontal and vertical, were designed with radii of 200, 400, and 1,600 feet. The 200- and 400-foot radius curves had a single angle of 2°52′ and 5°44′, respectively, cast into the bell. Straight units had enough tolerance in the joint to make each succeeding transition required for the 1,600-foot radius curves. Owing to obvious difficulties in maintaining line and grade there was no overlap of horizontal and vertical curves.

When sufficient trench had been prepared ahead, the dragline was moved back to lay pipe until laying operations caught up with the pipe-manufacturing plant or until more trenching was necessary. An average of 16 pipe units was laid in an 8-hour shift, making it possible for the one dragline to keep ahead of the plant, which turned out 10 pipe units per day. This procedure was followed until the spring of 1941, when all pipe had been manufactured and the winter months had curtailed excavating, hauling, and laying. The dragline which had been used in the plant operations was then moved to the line and excavating and laying proceeded simultaneously.

After the pipe was lowered into the trench and brought to approximate line and grade, both bell and spigot were lubricated with green soap and drawn together, using a hand winch fastened in the pipe already laid. A long, bologna-shaped sack, filled with sawdust, was placed around the joint to keep dirt out of the grout recess while backfilling progressed.

Backfill to spring line was compacted with pneumatic hand tampers, except in free draining areas where sluicing was permitted, and loose backfill was then placed to the top of the pipe. At this point, the grout recess was flushed out with water and filled with grout. The inside joint was hand packed with dry grout, troweled, and curing compound was applied. Remaining backfill was placed to a minimum depth of 3 feet over the top of the pipe.

There are five monolithic concrete vent structures and seven steel-span drainage crossings in the line. The latter structures had wire mesh welded to the inside an doutside of steel pipe and both inside and outside surfaces received a gunite coat. In addition to the above, the completed line contains 25 minor concrete structures and 5 rock-paved overflow structures.

NOTES FOR CONTRACTORS

Specification No.	Project	Bids	Work or material	Low bidder Name	Low bidder Address	Bid	Terms	Contract awarded
977	Central Valley, Calif.	Oct. 17	Clearing part of Shasta Reservoir site	Wixson and Crowe	Redding, Calif.	[1]$1,270,000.00		*1941* Dec. 13
990	Provo River, Utah	Oct. 13	Weber-Provo diversion canal, stations 425 to 479.	Norman I. Fadel	North Hollywood, Calif.	97,345.75		Do.
995	All-American Canal, Ariz.-Calif.	Oct. 27	Coachella Canal, stations 4562 to 5726.	Morrison-Knudsen Co. and M. H. Hasler.	Los Angeles, Calif.	2,539,499.70		[2] Dec. 19
1000	Central Valley, Calif.	Oct. 29	Friant-Kern Canal, stations 6+10 to 301+60.	Fredericksen and Westbrook and Paul J. Tyler.	Sacramento, Calif.	989,280.00		[2] Dec. 18
1006	Provo River, Utah	Nov. 10	Duchesne Tunnel, stations 5+10 to 163+35.	Utah Construction Co.	Ogden, Utah.	1,156,105.00		[2] Dec. 19
1010	Columbia Basin, Wash.	Dec. 2	Penstock coaster gates for Grand Coulee Dam.	American Bridge Co.	Denver, Colo.	[3] 395,185.00	F. o. b. Gary, Ind.	Dec. 22
1011	Boulder Canyon, Ariz.-Nev.	Nov. 27	Butterfly valve for Boulder power plant.	Hardie-Tynes Manufacturing Co.	Birmingham, Ala.	[4] 179,000.00	F. o. b. Birmingham, Ala.	Dec. 13
1013	Columbia Basin, Wash.	Nov. 19	Hydraulic turbines and governors for units L-7, L-8 and L-9, Grand Coulee power plant	Newport News Shipbuilding & Dry Dock Co.	Newport News, Va.	[7]1,900,000.00	F. o. b. Newport News, Va.	Dec. 10
				Woodward Governor Co.	Rockford, Ill.	[8] 87,550.00	F. o. b. Rockford, Ill.	Do.
1014	Central Valley, Calif.	Dec. 8	Construction of hatchery building at Coleman station, migratory fish control.	Grant L. Miner.	Palo Alto, Calif.	56,866.00		*1942* Jan. 1
1015	Colorado-Big Thompson, Colo.	Dec. 10	Relocation of State Highway No. 9 at Green Mountain Dam.	George B. Henly Construction Co.	Albuquerque, N. Mex.	88,120.00		*1941* Dec. 19
1585-D	Central Valley, Calif.	Nov. 24	Construction of cold-storage plant at Coleman station, migratory fish control.	H. J. Schmiedeskamp	San Francisco, Calif.	23,817.50		Dec. 11
1587-D	do.	Dec. 8	Construction of garage and warehouse building at Coleman station, migratory fish control.	do.	do.	34,883.00		*1942* [2] Jan. 2
1588-D	do.	Dec. 18	Construction of residences at Coleman station, migratory fish control.	Grant L. Miner	Palo Alto, Calif.	36,530.00		*1941* Dec. 31
1590-D	Parker Dam Power, Ariz.-Calif.	Dec. 11	Tanks for switchyard at Parker power plant.	Dallas Tank & Welding Co.	Dallas, Tex.	812.52	F. o. b. Dallas	Dec. 20
1593-D	do.	Dec. 15	Carrier-current telephone apparatus for Phoenix, Coolidge and Tucson substations	General Electric Co.	Denver, Colo.	[7] 10,815.00	F. o. b. destination points	*1942* Jan. 2
1595-D	Columbia Basin, Wash.	Dec. 18	230-kilovolt coupling capacitors and potential devices and carrier line traps for Grand Coulee power plant.	do.	Schenectady, N. Y.	[5] 46,686.00	F. o. b. Almira, Wash.	Do.
						[6] 2,800.00	do.	Do.
D-38, 155-B	do.	Nov. 12	Rubber-insulated cable	General Electric Supply Corporation.	Spokane, Wash.	61,277.10	F. o. b. Odair, Wash. Discount ½ percent.	*1941* Dec. 12
22, 529-A	Boise-Anderson Ranch, Idaho.	Nov. 28	10,000 barrels of modified portland cement in paper sacks.	Oregon Portland Cement Co.	Portland, Oreg.	[4] 33,300.00	F. o. b. Mountain Home, Idaho. Discount 10 cents per barrel.	Dec. 22
2, 484-A	Carlsbad, N. Mex.	Dec. 3	5,000 barrels of modified portland cement in paper sacks.	Southwestern Portland Cement Co.	El Paso, Tex.	14,350.00	F. o. b. Carlsbad, N. Mex. Discount 10 cents per barrel.	Dec. 17
24, 861-A	Gila, Ariz.	Oct. 28	White pigmented concrete curing compound (25,000 gallons).	The Sullivan Co.	Memphis, Tenn.	21,250.00	Discount 2 percent	*1942* Jan. 7
A-33, 457-A-5	Central Valley, Calif.	Dec. 10	Steel reinforcement bars (3,000,000 pounds).	Republic Steel Corporation.	Cleveland, Ohio	[7] 97,500.00	F. o. b. Coram, Calif. Discount ½ percent.	*1941* Dec. 26
D-38, 200-A	Columbia Basin, Wash.	Dec. 15	Insulators (12,500)	Corning Glass Works	Corning, N. Y.	19,375.00		Dec. 30
D-38, 209-A	do.	do.	Concrete pumping machine and equipment.	Ray Corson Machinery Co.	Denver, Colo.	[8] 11,616.72	F. o. b. Milwaukee, Wis. Discount 2 percent.	Do.
F-23, 301-A	Boulder Canyon, Ariz.-Nev.	Dec. 19	Rubber-insulated cable.	Hazard Insulated Wire Works.	Chicago, Ill.	49,057.90	F. o. b. Boulder City, Nev. Discount ½ percent.	*1942* Jan. 5
A-33, 489-A	Central Valley, Calif.	Dec. 17	do.	Graybar Electric Co. Inc.	Denver, Colo.	43,682.80	F. o. b. Coram, Calif. Discount ½ percent.	Jan. 7

[1] Schedules 1, 2, 4, 5, and 8 to 15 inclusive. [2] All bids rejected. [3] Items 1 and 3. [4] Item 1. [5] Schedule 1. [6] Schedule 2. [7] Schedules 1, 2, 3, and 4. [8] Items 1, 2, 3, and 4.

CHALLENGE from page 29

can be produced profitably in the form of alfalfa and irrigated pasture.

Recent experiments in finishing lambs on irrigated pasture conducted by the College of Agriculture of the University of California show that by comparison with a control flock fed with a supplemental ration of alfalfa and barley under approved feed lot practices, irrigated clover pasture alone yielded 88 percent of the gain recorded with suppemental feed. From a monetary standpoint, it was reported that by using unsupplemented pasture it was possible to operate at a profit with a differential of $1 per hundredweight between the feeder price and the finished price.

Irrigated pasture in the Southwest has long been used to fatten feeder beef stock taken from the range. With increased shipping difficulties in meeting beef shortages through Argentine imports, and with the increased demands of the Pacific coast population centers, the importance of irrigated lands in this function is likewise increasing.

Whether the need is for dairy products, beef, fruits and vegetables, or wool, irrigated land provides a definite promise for increased yields. Of the many variables that comprise the complex of production, the most important one, water, is controlled through irrigation.

Federal Reclamation projects are capable of supplying water to 2,315,000 acres. In addition, its projects supply supplemental water to 2,263,000 acres inadequately irrigated from non-Federal works. The projects under construction or authorized will increase the supplemental service to over 7,000,000 acres, and increase the total acreage served with a full supply to more than 5,000,000 acres.

Prime Minister Winston Churchill, addressing the Congress on December 26, asserted that the Allies will assume the offensive in 1943. As the sphere of combat participation of the United States widens into total war the demands for food will increase. It is definite that 1943 and 1944 goals will exceed the 1941 production and the 1942 requirements.

Reclamation farms—75,000 of them—stand ready to respond. Reclamation works—creators of food, water and power, the three critical needs of a Nation at total war—will do their full share of winning the war, and the peace.

COMMUNITY HALL from page 45

although a few had done some building. They have done a fair job, by the aid of the dealer, of estimating the cost but sadly underestimated the amount of labor required.

In the early stages of the work we had lots of help but farming time came on and we all had lots of work at home that badly needed to be done. The help kept dropping out until it was mostly left up to a few faithful workers. We did a good job as far as we went. Put up the building, 24 by 38-foot and a full basement and a housed-in outside stairway to the basement. The electrical work was done by a licensed electrician from town. When it was completed all but the windows, chimney and double front doors, we all quit and went to farming.

Our opening night to the public was a box social which paid over $50 on the debt. We continued to give dances once or twice a month and by Christmas the debt had been cut down to less than $200 and the windows were in, an electric range installed for cooking, a fair piano in the hall, a 27-foot brick chimney built and a large heating stove put up. We plan another box social for the holidays between Xmas and New Year.

Again the Nyssa merchants are coming to our rescue. With prizes of different kinds to be given at the social. We expect this social to make another substantial payment on the hall.

A local chapter of the Grange was organized shortly after the hall was opened for use. Some of the new Grange members were from outside the local community but received a warm welcome. Later a cattle association was organized by the farmers that had a few cattle and wanted to get them out on the open range.

The county AAA has used the hall for to get the local farmers together. The county agent came out here and gave us a talk on noxious weeds.

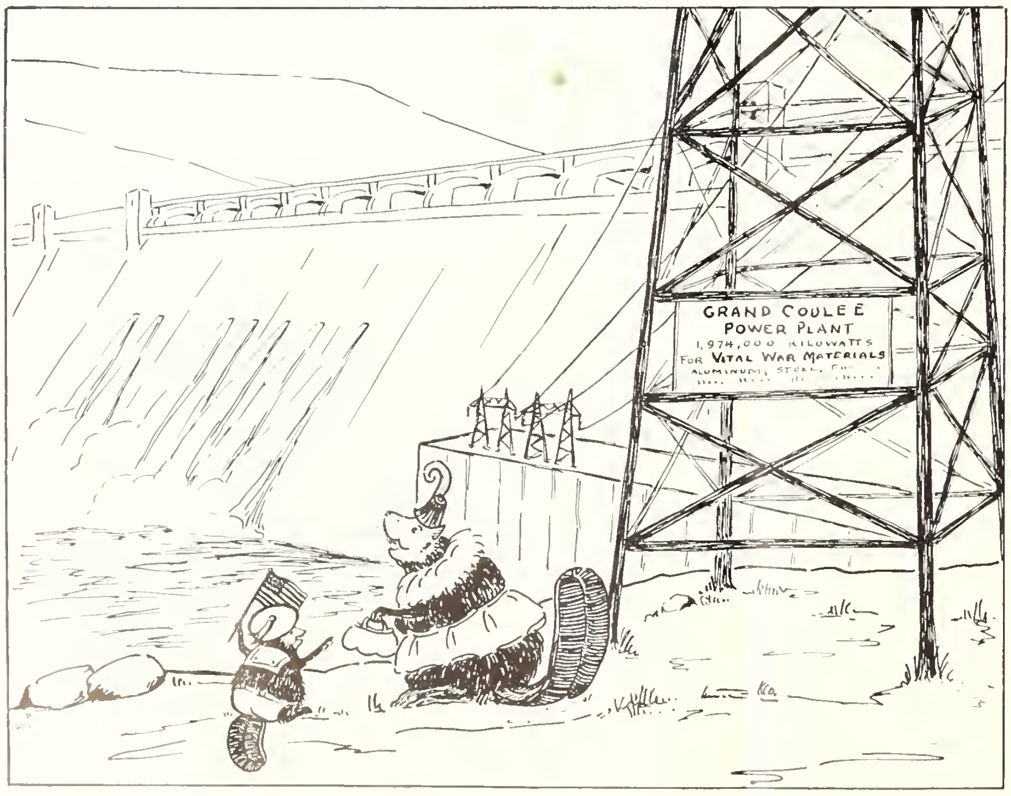
Our community hall is all and more than we expected of it. We built it with the idea of having a place of recreation without having to go clear to town. We especially wanted clean amusement for our young folks.

Every Rose Has Its Thorn

Every rose has its thorn. Don't expect a community hall to run smoothly all the time any more than you would expect a business to run smooth all the time. There is always the member who won't cooperate. There is the troublemaker too. You just have to get along with them. In a small community if you go to eliminating people the first thing you know you have a hall and no one to go to it.

SEVERAL THOUSAND translucent glass blocks will form the windows of the Grand Coulee Dam powerhouse, each 40 feet high and 17 feet wide.

"Can't Pop put a power plant on ours, too, Mom?"



HONOR ROLL

COLUMBIA BASIN PROJECT, WASHINGTON:

Rice, Harvey F., junior engineer. Second lieutenant, Inf.-Res., U. S. Army. Called to active duty June 11, 1941.

Rose, Robert N., burner, acetylene torch. Battery B, 52 B. N. F. A., 11th Training Regiment, Camp Roberts, San Miguel, Calif. Inducted into U. S. Army June 24, 1941.

Wisniski, William H., assistant engineer. First lieutenant, Engineer-Reserve, U. S. Army. Called to active duty October 3, 1941.

GILA PROJECT, ARIZONA:

White, Clarence, associate engineer. First lieutenant, CAC Reserve, U. S. Army. Furlough effective June 18, 1941.

PARKER DAM POWER PROJECT, CALIFORNIA:

Alexander, Leslie M., assistant engineer. Lieutenant, Army Reserve. Called to active duty August 22, 1941.

Cheney, George J., associate engineer. Lieutenant, Naval Reserve. Called to active duty September 26, 1941.

Ellsworth, Paul E., Jr., carpenter. Private, Camp Roberts, Calif. Drafted October 22, 1941.

Lattray, Robert, Jr., carpenter. Private, Fort Leonard Wood, Mo. Drafted July 1941.

PINE RIVER PROJECT, COLORADO:

Murray, J. J. junior engineer, U. S. Army Air Corps, Pasadena, Calif. Enlisted June 23, 1941.

RIO GRANDE PROJECT, NEW MEXICO-TEXAS:

Baclawki, Arthur, senior foreman (landscape, CCC Camp Br 54). Coast Artillery-Antiaircraft. Inducted into U. S. Army July 28, 1941.

Lawrence, Ray J., foreman. New Mexico National Guard (engineers). Called to active duty July 28, 1941.

McBride, Paul C., assistant engineering aide. New Mexico National Guard (engineers). Called to active duty July 28, 1941.

TUCUMCARI PROJECT, NEW MEXICO:

Luck, Angelo J., Jr., chairman. Second lieutenant, Infantry Reserve, U. S. Army. Called to active duty July 15, 1941.

DENVER OFFICE:

Hardy, Nils W., senior typist. U. S. Army. Inducted November 25, 1941.

Jones, Wilson B., junior engineer. Ensign, CEC–V(S); U. S. Naval Reserve, 12th U. S. Naval District, San Francisco, Calif. Called to active duty October 10, 1941.

Kuiper, Clarence J., assistant engineer. U. S. Army. First lieutenant, The Infantry School, Fort Benning, Ga. Called to active duty October 15, 1941.

Langendorf, John A., junior engineer. Second lieutenant, 89th Engineer Battalion, Fort Leonard Wood, Mo. Called to active duty September 10, 1941.

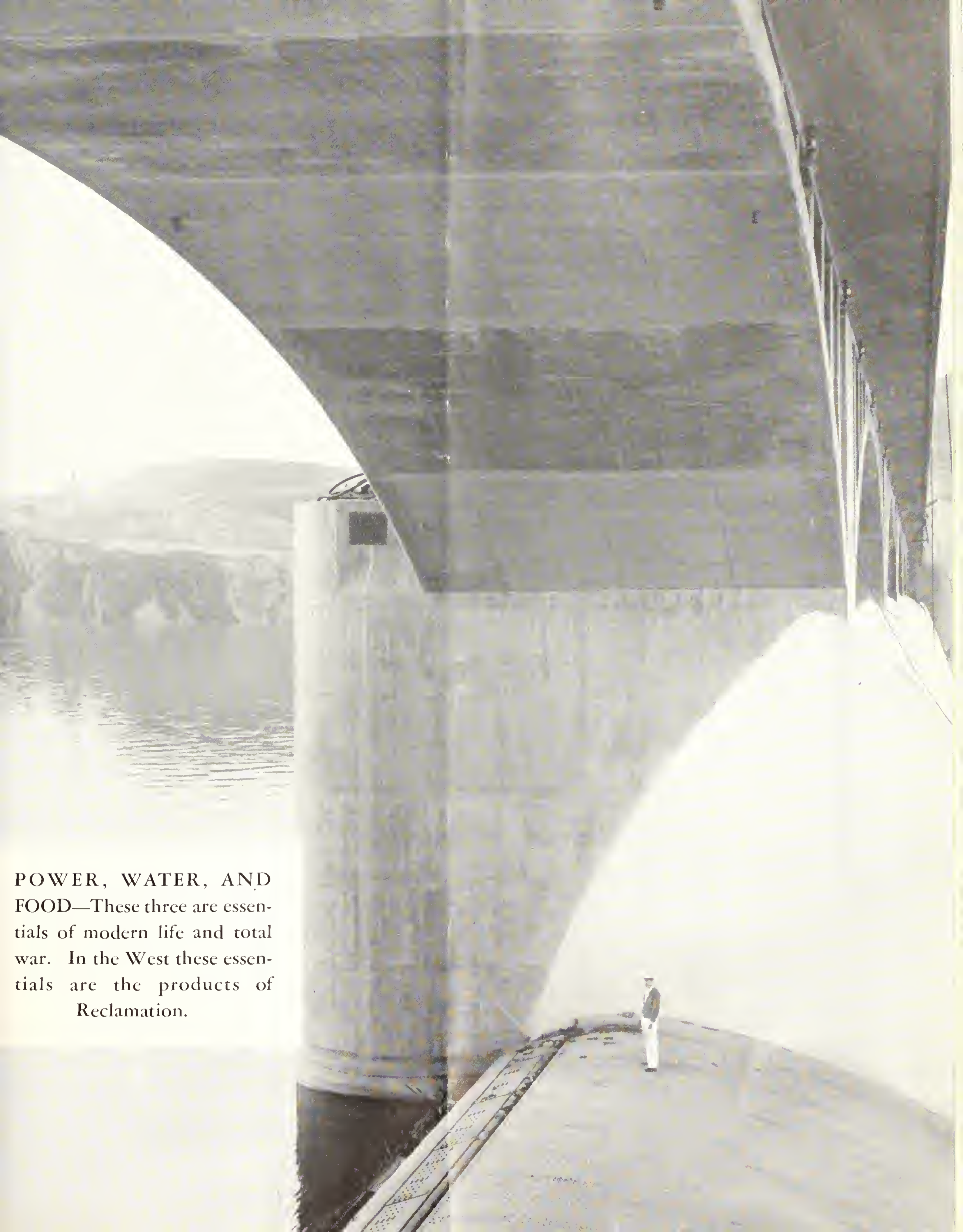
McCandless, Robert B., junior engineer. U. S. Army. First lieutenant, Infantry Reserve, Fort Benning, Ga. Called to active duty September 17, 1941.

Nelson, Wilford J. H., junior engineer. U. S. Navy. Inducted September 16, 1941.

Noel, John A., assistant engineering draftsman. Aviation Cadet, Pilot Replacement Center, Kelly Field, Tex. Inducted November 7, 1941.

Whitney, William J., junior engineer. Second lieutenant, F. A. Reserve, Air Corps Basic Flying School, Randolph Field, Tex. Called to active duty July 15, 1941.

437495 U. S. GOVERNMENT PRINTING OFFICE: 1942



POWER, WATER, AND FOOD—These three are essentials of modern life and total war. In the West these essentials are the products of Reclamation.

ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

HAROLD L. ICKES, SECRETARY OF THE INTERIOR

John C. Page, Commissioner — Harry W. Bashore, Assistant Commissioner

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Chief Engineer's Office, United States Customhouse, Denver, Colo.

S. O. Harper, Chief Engineer; W. R. Young, Assistant Chief Engineer; J. L. Savage, Chief Designing Engineer; W. H. Nalder, Assistant Chief Designing Engineer; L. N. McClellan, Chief Electrical Engineer; Kenneth B. Keener, Senior Engineer, Dams; H. R. McBirney, Senior Engineer, Canals; E. B. Debler, Hydraulic Engineer; I. E. Houk, Senior Engineer, Technical Studies; H. J. S. Devries, General Field Counsel; L. R. Smith, Chief Clerk; Vern H. Thompson, Purchasing Agent; C. A. Lyman and Henry W. Johnson, Examiners of Accounts

Operation and Maintenance Division, 910 U. S. National Bank Building, Denver, Colo.

John S. Moore, General Supervisor; Deane S. Stuver, Assistant Geueral Supervisor; L. H. Mitchell, Irrigation Advisor; H. H. Johnson, Field Supervisor (headquarters at Great Falls, Mont.); T. W. Parry, Field Supervisor

Projects under construction or operated in whole or in part by the Bureau of Reclamation

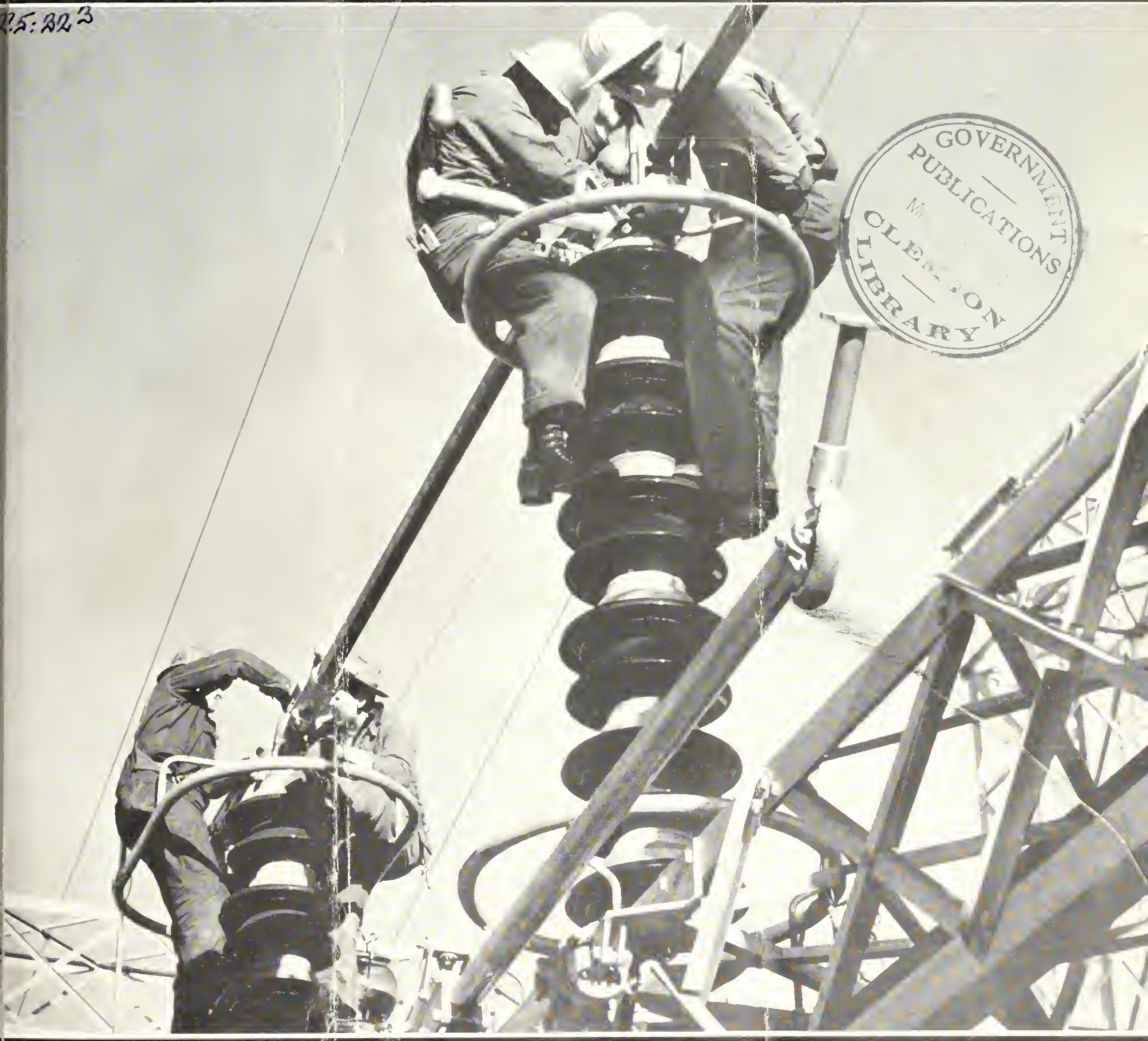
Project	Office	Official in charge		Chief Clerk	District counsel	
		Name	Title		Name	Address
All-American Canal	Yuma, Ariz	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Altus	Altus, Okla	Russell S. Lieurance	Construction engineer	Frank E. Gawn	Spencer L. Baird	Amarillo, Tex.
Belle Fourche	Newell, S. Dak	F. C. Youngblutt	Superintendent		W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Anderson Ranch Reservoir	Mountain Home, Idaho	John A. Beemer	Construction engineer		B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant	Boulder City, Nev	Ernest A. Moritz	Director of power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont	Paul A. Jones	Construction engineer	Edwin M. Bean	W. J. Burke	Billings, Mont.
Buford-Trenton	Williston, N. Dak	Parley R. Neeley	Resident engineer	Robert L. Newman	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex	L. E. Foster	Superintendent	E. W. Shepard	Spencer L. Baird	Amarillo, Tex.
Central Valley	Sacramento, Calif	R. S. Calland	District engineer	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Kennett division	Redding, Calif	Ralph Lowry	Construction engineer	F. W. Gilbert	R. J. Coffey	Los Angeles, Calif.
Friant division	Friant, Calif	R. B. Williams	Construction engineer	Geo. H. Witte	R. J. Coffey	Los Angeles, Calif.
Delta division	Antioch, Calif	Oscar G. Boden	Construction engineer	F. D. Helm	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Estes Park, Colo	Cleves H. Howell	Project engineer	C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex	Charles P. Seger	Acting construction engineer	William F. Sha	Spencer L. Baird	Amarillo, Tex.
Columbia Basin	Coulee Dam, Wash	F. A. Banks	Supervising engineer	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Davis Dam	Kingman, Ariz	Murray J. Miller	Engineer		R. J. Coffey	Los Angeles, Calif.
Deschutes	Bend, Oreg	Clyde H. Spencer	Construction engineer	Noble O. Anderson	B. E. Stoutemyer	Portland, Oreg.
Eden	Rock Springs, Wyo	Thomas R. Smith	Construction engineer	Emanuel V. Hillius	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Reno, Nev	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo	Irvin J. Matthews	Construction engineer	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Mancos	Mancos, Colo	Albert W. Bainbridge	Resident engineer	Harry L. Duty	J. R. Alexander	Salt Lake City, Utah.
Mann Creek	Weiser, Idaho	Louis B. Ackerman	Resident engineer	Ralph H. Ceibel	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont	Harold W. Genger	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Stanley R. Marean	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Mirage Flats	Hemingford, Nebr	Denton J. Paul	Construction engineer		W. J. Burke	Billings, Mont.
Moon Lake	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Newton	Logan, Utah	I. Donald Jerman	Resident engineer	Hugh E. McKee	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo	C. F. Gleason	Superintendent of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Ogden River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Orland	Orland, Calif	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam Power	Parker Dam, Calif	Samuel A. McWilliams	Construction engineer	George B. Snow	R. J. Coffey	Los Angeles, Calif.
Pine River	Vallecito, Colo	Charles A. Burns	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rapid Valley	Rapid City, S. Dak	Horace V. Hubbell	Construction engineer	Joseph P. Siebeneicher	W. J. Burke	Billings, Mont.
Rio Grande	El Paso, Tex	L. R. Fiock	Superintendent	H. H. Berryhill	Spencer L. Baird	Amarillo, Tex.
Riverton	Riverton, Wyo	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
San Luis Valley	Monte Vista, Colo	H. F. Bahmeier	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo	L. J. Windle	Superintendent		W. J. Burke	Billings, Mont.
Heart Mountain divisicn	Cody, Wyo	Walter F. Kemp	Construction engineer	John H. McCluer	W. J. Burke	Billings, Mont.
Sun River	Fairfield, Mont	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Tucumcari	Tucumcari, N. Mex	Harold W. Mutch	Resident engineer	Charles L. Harris	Spencer L. Baird	Amarillo, Tex.
Umatilla (McKay Dam)	Pendleton, Oreg	C. L. Tice	Reservoir superintendent		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo	Herman R. Elliott	Acting coustruction engineer	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Vale	Vale, Oreg	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash	David E. Ball	Superintendent	Alex. S. Harker	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash	Charles E. Crownover	Construction engineer	Geo. A. Knapp	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz	C. B. Elliott	Superintendent	Jacob T. Davenport	R. J. Coffey	Los Angeles, Calif.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	A. Oliver	President	Marion Hewlett	Keating.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont			Elsie W. Oliva	Hamilton.
Boise	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise	Black Canyon irrigation district	Notus, Idaho	Chas. W. Holmes	Superintendent	L. M. Watson	Notus.
Burnt River	Burnt River irrigation district	Huntington, Oreg	Edward Sullivan	President	Harold H. Hursh	Huntington.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont	Tom Sheffer	Superintendent	Ralph P. Scheffer	Huson.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	S. F. Newman	Superintendent	A. W. Lanning	Austin.
Grand Valley Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo		Superintendent	C. J. McCormick	Grand Jctn.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Roy F. Meffley	Superintendent	C. H. Jones	Lovelock.
Huntley	Huntley Project irrigation district	Ballantine, Mont	S. A. Balcher	Manager	H. S. Elliott	Ballantine.
Hyrum	South Cache W. U. A	Logan, Utah	H. Smith Richards	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley	Langell Valley irrigation district	Bonanza, Oreg	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly	Horsefly irrigation district	Bonanza, Oreg	Benson Dixon	President	Dorothy Eyers	Bonanza.
Lower Yellowstone	Board of Control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	R. H. Clarkson	Chinook.
	Fort Belknap irrigation district	Chinook, Mont	H. B. Bonebright	President	L. V. Bogy	Chinook.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery	Chinook.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	President	R. L. Barton	Harlem.
	Paradise Valley irrigation district	Zurich, Mont	C. J. Wurth	President	J. F. Sharples	Zurich.
Minidoka: Gravity	Minidoka irrigation district	Rupert, Idaho	Frank A. Ballard	Manager	Frank A. Ballard	Rupert.
Pumping	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Moon Lake	Moon Lake W. U. A	Roosevelt, Utah	H. J. Allred	President	Louie Galloway	Roosevelt.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	W. H. Wallace	Manager	H. W. Emergy	Fallon.
North Platte: Interstate division	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division	Cering-Fort Laramie irrigation district	Gering, Nebr	W. O. Fleenor	Superintendent	C. G. Klingman	Cering.
Fort Laramie division	Goshen irrigation district	Torrington, Wyo	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division	Northport irrigation district	Northport, Nebr	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden.
Okanogan	Okanogan irrigation district	Okanogan, Wash	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt River	Salt River Valley W. U. A	Phoenix, Ariz	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Sanpete: Ephraim division	Ephraim Irrigation Co	Ephraim, Utah	Andrew Hansen	President	John K. Olsen	Ephraim
Spring City division	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larson	President	James W. Blain	Spring City.
Shoshone: Garland division	Shoshone irrigation district	Powell, Wyo	Paul Nelson	Irrigation superintendent.	Harry Barrows	Powell.
Frannie division	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	Manager		Deaver.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo F. Clark	Superintendent	F. A. Baker	Stanfield.
Strawberry Valley	Strawberry Water Users' Assn	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division	Fort Shaw irrigation district	Fort Shaw, Mont				
Greenfields division	Greenfields irrigation district	Fairfield, Mont	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division	Hermiston irrigation district	Hermiston, Oreg	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre	Uncompahgre Valley W. U. A	Montrose, Colo	Jesse R. Thompson	Manager	H. D. Calloway	Montrose.
Upper Snake River Storage	Fremont-Madison irrigation district	St. Anthony, Idaho	H. G. Fuller	President	John T. White	St. Anthony.
Weber River	Weber River W. U. A	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Ogden.
Yakima: Kittitas division	Kittitas reclamation district	Ellensburg, Wash	G. G. Hughes	Manager	G. L. Sterling	Ellensburg.

THE RECLAMATION ERA

MARCH 1942



These Men Are Fighting Too

IN THIS ISSUE

THIS MONTH'S COVER

Installing Disconnecting Switch Insulators, Switchyard, Grand Coulee Dam Power Plant

(Date)

Commissioner,
Bureau of Reclamation,
Washington, D. C.

Sir: I am enclosing my check [1] (or money order) for $1.00 to pay for a year's subscription to The Reclamation Era.

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The WAR PROGRAM of the Department of the Interior

. . . TO MOBILIZE, on the scale made necessary by global warfare, the strategic natural resources of the Nation

. . . TO SUPPLY essential raw materials, ores, minerals, metals, fuels, and power to industrial processors and fabricators in order to attain the national war production goals set by the President

. . . TO DEVOTE to winning the war the full knowledge and experience gained through years of study, conservation, and development of these resources

. . . TO FURNISH technical aid and information promptly to the War Production Board and industries or agencies processing raw material for war

. . . TO REQUEST proper authority or financing as needed.

Metals for War

***MACHINES** have made this war unique, and have raised metals to first rank among essential war material. Only an increasing production of ores can keep the factories running, labor busy, and the Army and Navy supplied with fighting planes, weapons, and ships. Years of exploration and experiment have prepared the Geological Survey and the Bureau of Mines to move the country forward toward production on a victory scale by turning known but unused, low-grade materials into metals now more vital than gold.*

The Department proposes:

1. To secure the immediate use of new processes discovered or tested in its own laboratories which can supply enough manganese to make 87 million tons of steel annually from low-grade domestic manganese ores and save millions of tons of shipping and convoys; to aid in opening up 50 ore bodies; to aid in establishing 12 plants in Arizona, Arkansas, New Mexico, Minnesota, Montana, Nevada, South Dakota, and Utah and later in other States as warranted. In the event industry is unable to produce the needed manganese, the Department stands ready to design, construct, and operate the plants. *Bureau of Mines.*

2. To secure the immediate use of the best process for producing alumina, the raw material for aluminum, from alunites, leucites, clays, shales, and sands; to supply "cookbooks" for men who want to help the war program by roasting such readily available resources to produce alum, the first ingredient of the new process. To aid in the establishment of plants for using the process and to aid plants using the new process to speed up their production. To make available its recommendations, testing experience, and engineering personnel for the use of the new magnesium processes utilizing domestic ores. To complete and secure the prompt use of a process for producing 1 million tons of chromium concentrates annually from low-grade chromium ores. In the event that industry is unable to produce the needed quantities of these three critical materials, the Department stands ready to undertake the design, construction, and operation of the necessary plants. *Bureau of Mines.*

3. To explore for copper in California, Nevada, Utah, Arizona, Colorado, New Mexico, Tennessee, and Michigan; to begin explorations for zinc in Missouri, Kansas, Idaho, Utah, Nevada, Montana, Colorado, New Mexico, Wisconsin, Tennessee, Oregon, and Washington; to explore for lead in Colorado, Idaho, Kansas, Missouri, Montana, New Mexico, Oklahoma, Utah, and Washington; to explore for iron in Alabama, California, Minnesota, Michigan, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Tennessee, Utah, Washington, Wisconsin, and Wyoming; and to speed explorations for chromite in Alaska, California, Montana, Oregon, and Washington. To speed exploration for additional bauxite, alunite and aluminous clays. To make the records of all the explorations available promptly to all interested. *Geological Survey, Bureau of Mines.* To supervise operations on zinc and lead properties on Indian lands which represent over one-tenth of the Nation's supply. *Office of Indian Affairs, Geological Survey.*

4. To speed exploration for vanadium, tungsten and mercury sources; to investigate with increased speed methods of processing the ores more efficiently and rapidly, and to propose properly located custom mills. To increase the output of iron by utilizing a process for making sponge iron through gaseous reduction of ores and through subsequent smelting in electric furnaces, giving particular attention to Western iron ores. To develop processes for conversion of low-grade copper, nickel, lead, and zinc ores, also of boron lithium, sodium, barium, beryllium. To speed the exploration of essential nonmetallic minerals such as mica, graphite, asbestos, steatitic talc. Through the Consulting Committee on Northwestern Phosphates, to help make available vanadium or phosphorus for war and large amounts of low-cost fertilizers for the Western farmers. *Bureau of Mines, Geological Survey.*

5. That all drilling and mining records of persons mining all the critical minerals be made available on a confidential basis to the Bureau of Mines, so that its exploration for additional sources can be speeded and conducted economically; and that colleges, universities, and state departments of mining and conservation can be enlisted to make available the services of the engineering faculties for exploratory work. *Bureau of Mines, Geological Survey.*

6. To expand examination of patents and processes covering minerals needed for the war which are held by enemy aliens and to test and recommend the best for use; to recommend that all patents and processes of private companies covering the processing of raw materials needed for the war as well as the records be submitted confidentially to the Bureau of Mines to enable it to recommend plants for wider use of the best available processes; and to provide every user of processes developed by the Department or recommended by it, if required with the advice and services of Bureau of Mines engineers to help in rapid and economical development. *Bureau of Mines.*

7. To begin a national round-up of new metal resources by encouraging scientists and educational institutions to place in the hands of cattlemen, prospectors, science teachers, and others in likely areas charts describing minerals needed for war, together with ore samples, where possible, and instructions on reporting new findings. *Division of Information, Geological Survey, Bureau of Mines, Indian Office.*

8. To furnish the War Production Board as needed with a ranking of the best possible new developments of all critical ores, basing the ranking upon the latest ore-dressing tests, the latest explorations, and upon the expected quantity, speed and cost of production. To formulate for the War Production Board a domestic ore-buying program, and to stand ready to supervise it if requested. *Geological Survey, Bureau of Mines.*

9. To protect mining and all forms of industrial production by the control of the handling

of explosives through licensing persons permitted to manufacture, distribute, purchase, possess, and use explosives and through supervising the care and storage of explosives. *Bureau of Mines.*

Oil for War

Without petroleum products, the war machine which the United States and the United Nations are now perfecting could not function. National petroleum production must be increased by the most efficient methods to fill mounting requirements. The production and operation of mechanized armies, self-propelled artillery, substratosphere bombers, multiple-ocean navies require unfailing supplies of high-quality gasoline and lubricants and other oil products. The expanding industrial second line of defense and the third front at home also must be supplied. To meet the requirements, United States production may have to be raised to 1,500,000,000 barrels of oil a year.

Preparations to meet the challenge were made through the Office of the Petroleum Coordinator, which was established seven months before Japan made the Pacific a misnomer for the western ocean.

The Department proposes:

1. To organize petroleum production based upon sound engineering techniques so that operating wells and fields can produce at sustained rates without injury to our remaining reserves and so that the crude oils, condensates from high-pressure fields, and natural gasolines needed for aviation gasoline and lubricants, toluene, synthetic rubber, and other specialized products will be available in the quantities required when needed; to stimulate exploration for new reserves, and, through cooperation with State regulatory bodies, to leave in safe underground storage those crude oils not immediately important to the war effort. *Office of the Petroleum Coordinator.*

2. To multiply the industry's capacity to manufacture high-octane gasoline for war planes to as much as 200,000 barrels per day; to stimulate financing and erection of 100-octane plants; to control closely the aviation gasoline supply to insure its appropriate use; to organize the natural gas and natural gasoline industries to meet plant fuel requirements and to obtain maximum production of the components of aviation gasoline, as well as rubber and other synthetic products, and to stimulate production of aviation lubricants. *Office of the Petroleum Coordinator.*

3. To establish new and more effective transportation methods required in moving blending stocks for aviation gasoline; to reshape the complex transportation system of the oil industry by substituting tank cars, trucks, barges, and pipelines for tankers diverted to war services. *Office of the Petroleum Coordinator.*

4. To formulate and, if needed, to direct marketing programs to insure the best distribution of available supplies for civilian uses in the event of the disruption of normal deliveries; to coordinate marketing and distributing facilities so as to maintain inventories, and to find and obtain petroleum products for use by the armed forces, essential industries, and civilian activities if normal channels of procurement do not bring about the necessary results. *Office of the Petroleum Coordinator.*

5. To formulate plans for the manufacture of essential components of synthetic rubber from petroleum products, including butadiene and styrene; and to stimulate expansion of plant capacity for the manufacture from petroleum of toluene for explosives. *Office of the Petroleum Coordinator.*

6. To engage in an active geological exploration campaign with the view of determining all possible areas in which prospective drilling for new deposits of petroleum and natural gas may be successful. To promote and encourage exploratory operations on lands owned or controlled by the United States having potential value for petroleum products; to take steps to insure adequate and proper development of known reserves on such lands, and to cooperate with industry and State authorities in attaining these objectives where such lands are interspersed with lands not under exclusive Federal control. *Geological Survey.*

7. To make available to the petroleum industry the latest developments in technical methods, practices, and procedures in the production, handling, transportation, and storage of petroleum and its products; to make available fullest technical guidance in the protection of petroleum in storage against deterioration, contamination, fire or sabotage, and other hazards; to keep the industry fully advised as to the trends of demands and requirements in order that it can gauge its necessary operations in advance so that the supply of products may be continuously available where, when, and as needed. To conduct all of these activities in such a manner as to bring all units of the petroleum industry, large and small, into the war program; and to execute that program so that no unnecessary dislocation of competitive positions in the industry, or hardship to the general public, shall occur. *Office of the Petroleum Coordinator, Geological Survey, Bureau of Mines, Petroleum Conservation Division.*

Power for War

The war budget of 56 billion dollars will require 15¼ billion kilowatt-hours of electric energy annually for the manufacture of airplanes, tanks, guns, warships, and fighting material, and to equip and serve the men of the Army, Navy, and Marine Corps.

The requirement for power to meet the President's war program exceeds the total production of energy for all electric utilities in the United States in 1940. Solely to provide the aluminum for the President's goal of 60,000 new planes this year will require 8½ billion kilowatt-hours.

Germany, Japan, Italy, and the nations which the Axis has subjugated had in 1940 more than half again as much electric energy as was produced for all of the power systems which supplied the peacetime requirements of the United States. This must be overcome by the conservation, diversion, and expansion of power.

The Department is the major producer of power in areas where the principal undeveloped resources are located. The Department produced in 1941 more than 5 billion kilowatt-hours, and by this was able to increase by one-fourth the Nation's aluminum production. Units recently completed at Boulder, Bonneville, and Grand Coulee Dams now make the Department ready to produce at the rate of 7 billion kilowatt-hours annually.

The Department Proposes:

1. To triple its 1941 output through the following program of installation which is now under way:

Time	Cumulative total kilowatts of capacity	Kilowatt-hours produced annually
Dec. 7, 1942	2,010,987	10,785,000,000
Dec. 7, 1943	2,461,587	13,322,000,000
Dec. 7, 1944	3,293,087	18,501,000,000
Dec. 7, 1945	3,819,187	21,712,000,000

Bureau of Reclamation, Bonneville Power Administration.

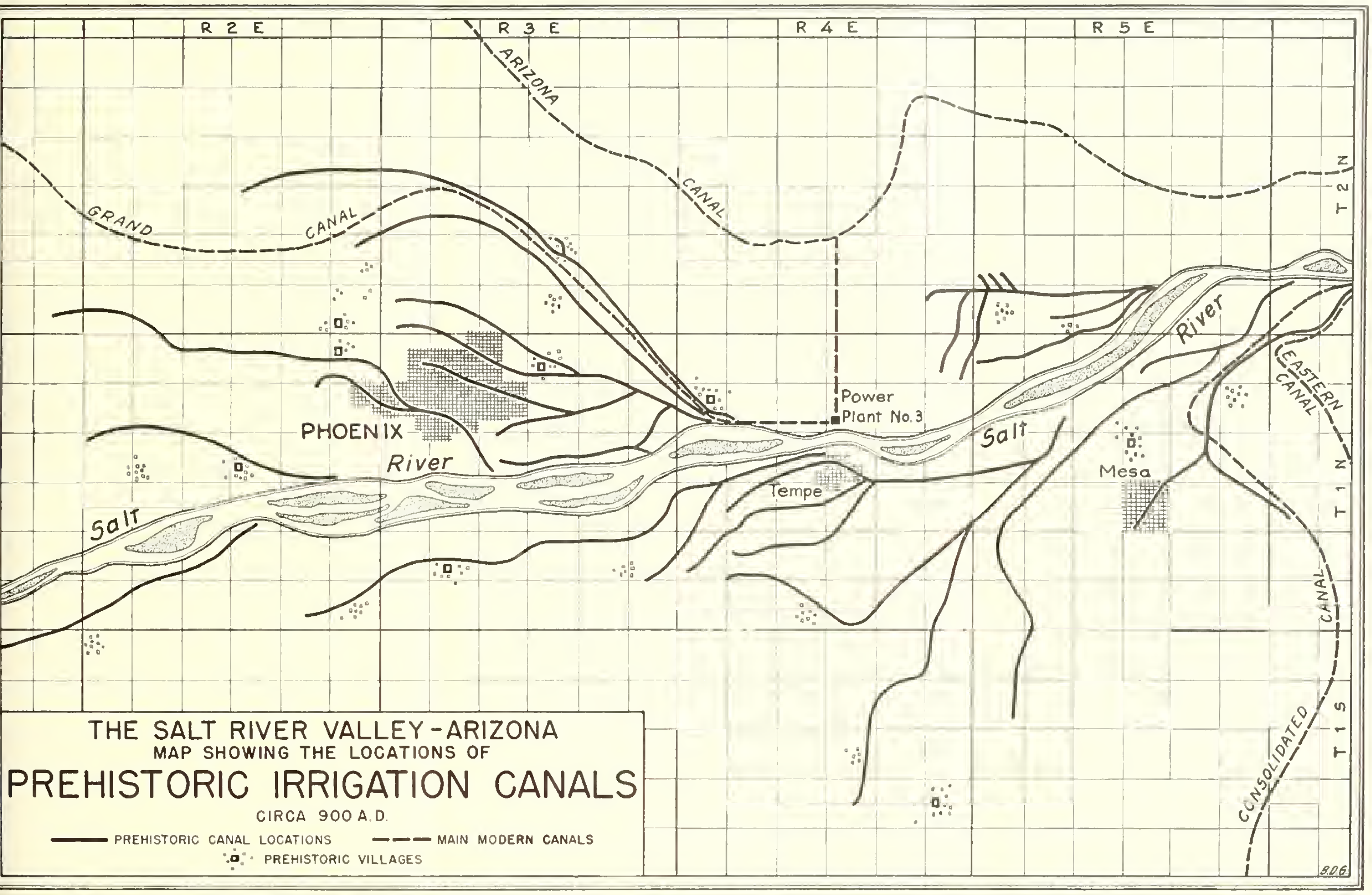
2. To add by 1945 about 1,480,000 kilowatts, with an output of 9 to 10 billion kilowatt-hours, to the power capacity now scheduled, by constructing new hydroelectric and steam plants. *Bureau of Reclamation.*

3. To advance a program by which 7,500,000 additional kilowatts with an annual output of 35½ billion kilowatt-hours can be made available within 5 years in the Western States; to recommend construction of component parts of this program as needed; and to anticipate demands in order that construction plans may be in hand when needed. *Division of Power, Bureau of Reclamation, Bonneville Power Administration, Office of Indian Affairs, Geological Survey.*

4. To allocate the use of its power among war industries in order to obtain the efficient development of local mineral resources and the greatest possible stabilization of local economies in the post-war period consistent with the fundamental purpose of prosecuting the war. *Division of Power, Bonneville Power Administration, Bureau of Reclamation.*

5. To gather and disseminate data and information on stream flow fundamental to the operation and expansion of electric plants and to supply information on water-power sites to those proposing to make developments. *Geological Survey.*

See WAR PROGRAM, *page* 70



"The People Who Have Gone Away"

By BEN D. GLAHA
Chief Photographer

More than 1,000 years ago the Ho-bo-kams lived and flourished in the Southwest. Their civilization was based on irrigation. Their culture reached a high peak. Edifices surprising to today's architect were erected. Then they disappeared. Why?

A MOTORIST approaching Phoenix, Ariz.—perhaps over U. S. Highway 60 from the West—travels through one of the most desolate arid areas in the world.

If the season is summer and some urgency forces the traveler on the road at midday, the heat is almost unbearable. A relentless sun beats down from a brazen sky. The road ahead disappears in a shimmering haze of heat waves. On either side the desert stretches away to verdureless mountains.

One finds himself in a landscape which has remained parched for thousands of years. Everything that lives there repels man's advances. Centuries of evolution have arranged for everything that grows or crawls either to stab or to sting.

The giant saguaro cactus dominates the landscape, while a precarious growth of lesser cacti and a varied chaparral cling close to the earth. Animal life is limited to a few species of reptiles—survivals of prehistoric monsters.

But just when the traveler has decided that this inhospitable waste must be limitless, the road suddenly crosses a bridge. The bridge spans a channel of clear water. The bank of the canal is bordered with trees, and there is the grateful green of growing fields. The wind which on the desert had been scorching is here almost cool. Where human habitation had been limited to a few shadeless gasoline stations, there are now neat farmhouses set in green gardens on either side. A stranger, entering suddenly into this oasis, might well think he was encountering a miracle, and in a sense a miracle it is—the miracle of modern irrigation.

But the word modern, though used advisedly, possibly is not altogether accurate, for the basic practices of irrigation are ancient, and irrigation itself is perhaps the oldest art of man. The hanging gardens of Babylon were irrigated terraces; the valley of the Euphrates was an irrigated oasis, the spoils for which many ancient wars were fought; and the Egypt of the Pharaohs dominated the civilization of its day because of irrigation.

As a matter of fact, the fruitful valley of the Salt River in the environs of Phoenix, through which the motorist is now driving, was the scene of an agrarian culture so many hundreds of years ago that the origin and the fate of the Indian peoples who developed and lost it are scarcely traceable. These people are even without a name save with the neighboring tribes, among whom fragments of their history have been handed down. The Pimas, who today live farther to the west of the region, call them the "Ho-ho-kam," which word may be loosely translated as "the people who have gone away" and itself bespeaks the tragedy of their decline.

Just when the Ho-ho-kam occupation of the Salt River Valley began cannot be determined, but there are indications which lead to the belief that a flourishing agri-

Remains of communal structure at Pueblo Grande, near Phoenix

culture had developed by the year 800 A. D. and that the culture extended for a period of some 300 years or more. The origins of these peoples are also in doubt, but it is certain they were a race apart from their Pueblo neighbors to the north, as well as from the desert tribes to the south and west. The practice of irrigation also identifies them separately because the Pueblos did not resort to this method of agriculture but relied upon the infrequent rains to mature their scanty crops. In fact, the canal irrigation developed in the Salt River Valley and, to a lesser extent, along the Gila River to the south provides the best, if not the only, examples of prehistoric irrigation of an advanced type in North America.

The Ho-ho-kam landhold probably was established through a system of villages based upon some sort of clan or family organization, presumably ordered on a strongly matriarchal system such as obtained among the other early tribes of the southwest and which still persists.

They built large communal buildings such as Pueblo Grande, the remains of which are at present being restored on the outskirts of Phoenix, but these larger structures were not used as dwelling places as was and is the case with the Pueblos. They were used as storage houses, granaries, and as a central refuge where the inhabitants of the outlying villages and jacals could seek protection at times of attack. Remains of masonry walls, varying in thickness from 3 to 10 feet, are found surrounding a compound enclosing the communal structures.

The uncovering of crematory pits affords an accounting of the prehistoric agriculture of the area. From the charred remains brought to light by these excavations, we learn that maize, beans, squash, and several small grains were the principal crops.

An aerial survey in 1930 disclosed about 125 miles of traceable canals, some of which extend a distance of 10 miles from their source at the river. During the prehistoric occupation of the valley, the Salt River was not the wide stream it is today but occupie[d] a narrower, much deeper channel. Henc[e] because of this widening erosion, there a[re] few points at which the present remains [of] the canal systems can be traced to the riv[er] itself.

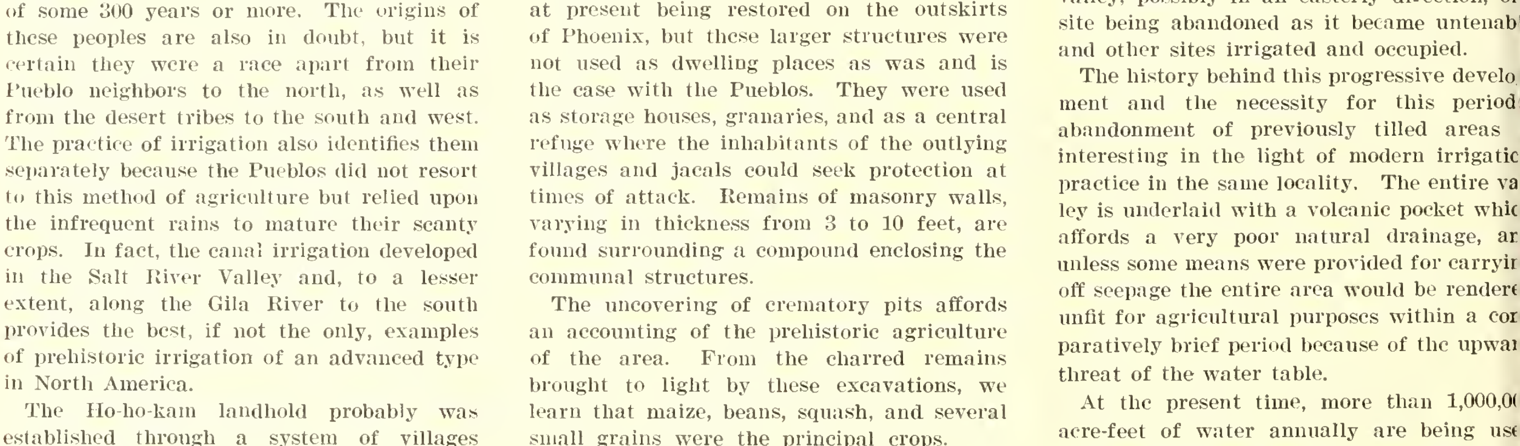
Many of the canals were 30 feet wide fro[m] bank to bank at their crests and from [?] to 10 feet deep. They were excavated wit[h] stone hoes, which were more than likely use[d] without handles, and the material carrie[d] away in burden baskets on the backs of th[e] patient toilers and built into the banks. [A] surprising appreciation for grade is exhibite[d]. The base slope was established, apparentl[y] simply by starting the water into the hea[d] excavation and by observing the velocity [as] the channel was extended. The fact tha[t] many of the canals are on a slower gradien[t] than that indicated in modern practice seem[s] to support this assumption.

The entire valley probably was neve[r] occupied at a single time by the Ho-ho-ka[m] peoples. There are indications that the agr[i]cultural development progressed through th[e] valley, possibly in an easterly direction, o[ne] site being abandoned as it became untenab[le] and other sites irrigated and occupied.

The history behind this progressive develo[p]ment and the necessity for this period[ic] abandonment of previously tilled areas [is] interesting in the light of modern irrigatio[n] practice in the same locality. The entire va[l]ley is underlaid with a volcanic pocket whic[h] affords a very poor natural drainage, an[d] unless some means were provided for carryi[ng] off seepage the entire area would be rendere[d] unfit for agricultural purposes within a co[m]paratively brief period because of the upwa[rd] threat of the water table.

At the present time, more than 1,000,0[00] acre-feet of water annually are being use[d] for irrigation purposes on the Salt Rive[r] project, of which about one-fifth goes in[to] the ground as seepage, which seepage, if le[ft] undisturbed, would raise the water tab[le] from 3 to 5 feet each year. This difficult[y]

Left to right: (1) Charred remains of beans and corn excavated from crematory pit. (2) Large prehistoric irrigation canal. (3) Ancient irrigation ditch filled with the deposits of centuries



ow is overcome by providing artificial drainge and by pumping off this excess. At presnt about 300,000 acre-feet of water are umped from the Salt River project each ear and utilized as an additional irrigation upply or wasted back into the river, but the rehistoric Indian farmers had no drainage acilities. As one area was slowly converted nto a bog through the application of an exess amount of irrigation water, they abanloned it and developed new fields.

What became of the main body of the tribe an only be guessed, but it is possible that wing to the decline of agriculture and the esultant shutting off of its means for surival, the tribe as a whole suffered a serious legeneration so that the final exodus was ccomplished by only a few who wandered nto the desert to be lost or were absorbed nto neighboring tribes without exercising an ppreciable influence upon the culture of their dopters. It is difficult to arrive at even an pproximate date of the extinction of the Ho-ho-kam development. It is known definitely that no remains of this culture were seen in the valley by Padre Kino who traversed this section in the year 1680.

Abandoned by the Indian farmers, as far as can be ascertained, about 1300 A. D., the valley ay open to the encroachment of the desert until it was settled by Mormons about 1865. During the next 60 years of its occupancy, about one-third of the irrigable lands in the valley was rendered unfit for cultivation because of seepage. With the alleviation of this condition, additional lands have been progressively brought under cultivation until today the valley is one of the richest and most productive agricultural communities in the United States.

Scattered throughout the southwest are examples of primitive irrigation, more than likely stemming from the Ho-ho-kam influence. One of the most interesting of these is encountered near Montezuma Wells, Ariz., where water from a deep artesian well was used to irrigate several hundred acres of arable lands bordering a small stream rising at the well itself. Seeping through the crater cone built up through centuries when the discharge from the well was much more voluminous, the water carries a high percentage of calcium salts in solution which deposit a coating of porous limestone along the banks of the channel through which it flows. The route of this early canal can be easily traced today by following these parallel deposits which mark the side slopes of the prehistoric channel. For several hundred feet this canal is still in use, but beyond that point has been abandoned for current usage due to too slow a gradient. Every indication dates this system much later than the Salt River canalization.

We are too prone to look upon the devices of modern irrigation as the work of our present-day engineers, but the revelations of archaeologists have demonstrated time and time again that the majority of them are but refinements of basic practices in use for centuries or more. The Picuris Indians in central New Mexico utilize hollowed logs as flumes, and it may safely be assumed that this practice had been customary for many, many years prior to the arrival of white men.

Thus the archaeologist shows that the true pioneer of irrigation on our western deserts was in reality not the engineer with his transit and chain—not even the early settler with his Mormon scraper. Rather, he was some half-naked savage with a stone hoe who, faced with the direst necessity for wresting an existence from the forbidding earth, laboriously gouged out his canals. To some long-forgotten aboriginal red man goes the honor of the first dimly glimpsed vision of "desert lands made fruitful."

NOTE.—The writer wishes to acknowledge a debt to Mr. Odd S. Halseth, city archaeologist, Phoenix, Ariz., and his staff, who made available the source material from which this article was prepared and kindly permitted the photographing of the ruins of Pueblo Grande and artifacts in the museum.

The people who live there—around Phoenix (risen anew from the ashes), Arizona—today depend on these modern creations of the irrigation engineer and Roosevelt Dam (upper) and a main canal (lower), Salt River Reclamation project, Arizona

Water Saved—Money Saved

Would you be money ahead if you irrigated with the water you waste and wasted the water you irrigate with? Mr. Rodner speaks straight from the shoulder to every irrigation farmer in this article packed with fact. Read it.

By JACK W. RODNER
District Conservationist

A GOOD MANY irrigation farmers would be money ahead if they irrigated with water they waste and wasted the water they irrigate with. Staggering erosion losses, poor crop yields, loss of plant nutrients and top soil, big bills for excess water, add up to bankruptcy for the farmer and ruin for the farm.

Such tragic consequences can be avoided in large measure by attention to a few simple principles of soil and moisture conservation. All depend, primarily, on a wise use of water regardless of soil, climate, and topography.

Running water into the head ditch without an accurate measure is about as wise a move as buying a farm without asking the price. An irrigator must pay for all the water he takes. If he wastes half of it he doubles his water cost. This money loss comes right out of his pocket every year. Yet it all too often goes unnoticed, an apparently essential item adding to the cost of farming. Most crops will tolerate a considerable shortage or excess of water. Nevertheless there is a comparatively narrow limit within which the best growth and the best yield is obtained. If more or less water is applied the crop suffers. While drought-danger is well understood, the less obvious evils of overirrigation rarely get much notice.

Unfortunately, when excessive uncontrolled amounts of water are used the best soil is washed off shortly after land is brought under ditch. Uncontrolled water coursing over the field picks up huge loads of fluffy top soil and carries it away down the waste ditches or piles drifts of it at the low end of the farm. And with it goes a big part of the land's organic matter. It is always low in semiarid lands—a precious heritage stingily deposited through centuries of little rain and scant vegetation. A quarter century of careful cultivation will not replace what can be lost in a year or two.

As the top washes away the sandier more porous levels are brought nearer the surface and the water-holding capacity of the soil becomes less and less. It becomes more like a sieve than a sponge. Water no longer seeps slowly through the soil, fanning out under the plants and around the roots. It now trickles straight down out of reach of crops. Or it is stopped by the hardpan, and fills the field like a reservoir until it is hopelessly waterlogged.

Now, more and more water must be turned into the field. So much water that it will leave enough moisture in the plant zone before it drops out of reach. Thus, tendencies towards gulleying are speeded up. Soluble mineral elements (in which semiarid lands are initially rich) are quickly leached out. In a few years, land that would give a careful irrigator an ever-increasing good living provides a profitless existence at best.

Under the best of circumstances, many difficulties face a settler on newly irrigated land. Primarily he is (1) inexperienced in handling water, (2) inexperienced in preparing land for irrigation, (3) and ill-prepared to plan and put in an irrigation system with adequate capacity and positive means of control. Untold irrigation systems have grown up piecemeal, without plan, and cannot justly be called "systems" at all. Yet a sound system is as easy to build as a makeshift system. It is easier to operate, and no more expensive. Extremely low-cost irrigation systems may lack the permanence and convenience of more expensive systems, but they will do the irrigation job just as well.

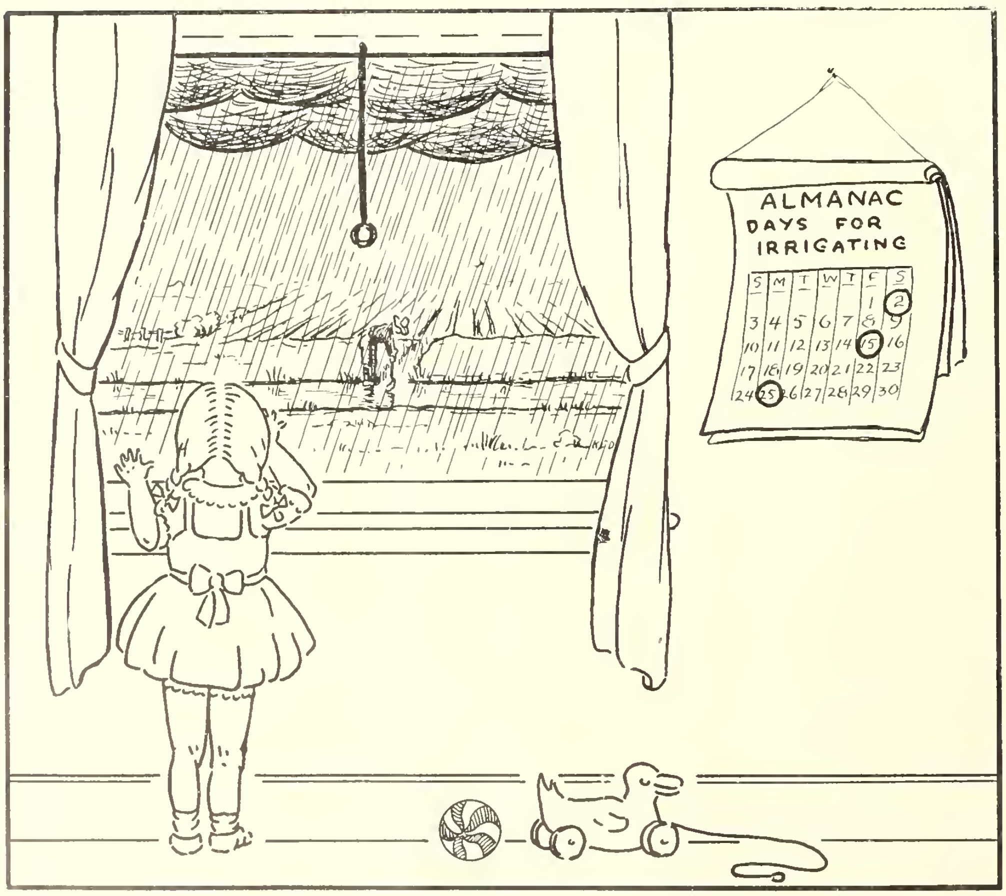
A simple measuring device and an accurate gage make it easy to control the amount of water in the head ditch. Regardless of his methods of controlling actual deliveries to the field, an irrigator must know how much water runs into the head ditch—how much water, in total, he is using.

Pipes, flumes, sprinklers, home-made spiles, and many other means for controlling the flow of water to the crop are available to the settler. Very elaborate permanent systems are, of course, expensive. Some controls cost little more than the effort to make them.

No irrigation system is worth much if the ground is not properly prepared. Usually there is just a small difference between proper and improper land preparation. But that difference is vital.

Once a good irrigation system is set up and the ground properly prepared, a sound crop plan must follow. Even if irrigation practice were perfect, land could still deteriorate through improper cropping. His need for ready cash often leads a new settler into wrong cropping habits at the start. Cash crops are the most difficult type to grow safely on newly irrigated land. They should be only a part of a sound crop rotation plan.

Yet the settler needs cash. He grows sev-



"Mamma, why does Daddy get to go out and play in the rain?" "But, dear, he's not playing—This is his day to irrigate"

eral cash crops. In the meantime he is justly alarmed as he sees the chocolate-colored water in the waste ditches carrying away his top soil. But eventually the fluffier soil is gone. The water clears up and lulls the farmer into a false sense of security. Vertical erosion may be playing worse havoc with his lands, but the process does not show. In the end he and the farm are ruined.

Yet, through cropping rotation, the soil can be vastly improved over its original condition. This fact becomes important as war needs press heavier demands on the irrigation farmer. A few years of intensive cropping without regard to soil and moisture conservation principles can do irreparable damage. On the other hand, irrigated areas can meet every demand made on them and still maintain the land if proper care is exercised. Soil-building crops must follow soil-depleting crops in rotation. Crops in both categories are needed in the war effort so no sacrifice of national welfare is involved. Legumes must be grown to replace the soil's store of nitrogen. Crop residues of every kind that add to soil fertility and organic content must be returned to the soil. Barnyard manures are not always available. Wherever they are, such manures are of prime value in establishing proper soil balance. Green manures in rotation are of considerable value. In the final analysis, the ease with which irrigation can be carried on is proportional to the organic content of the soil.

Irrigation by crop needs, not by the calendar, is the capstone of a soil and moisture conservation program. The writer has seen people irrigating during a rainstorm because that was the day scheduled for it. Observation will generally tell an experienced farmer whether his crops are in need of water. Moisture condition of the soil can be determined with a probe and by use of a simple soil auger. Even the irrigator's shovel will suffice. Soil structures on the individual farm govern the amount of water needed. By giving careful attention to crop needs, irrigation costs can be cut and the yield increased. And wasted water will not become a source of future losses.

Here, immediately and in condensed form, are some of the basic principles on which any irrigation farmer anywhere in the United States can build a soil and moisture conservation program:

(1) Use a measured amount of water; (2) applied in a manner to prevent surface and vertical erosion; (3) through means giving measurable control, such as flumes, pipes, sprinklers, spiles, etc.; (4) on sloping lands, cropping systems should be controlled by the topography; (5) return to the soil all crop residues having soil-building properties; (6) green manures in rotation, preferably combined with animal manures where available; (7) and *irrigation by crop needs, not by the calendar!*

The irrigation farmer who follows these rules cannot go wrong.

Boca Reservoir New Playground

By F. M. SPENCER
Acting Construction Engineer

AS WITH OTHER Reclamation projects whose serious objectives of irrigation water, power generation, flood control, and domestic and industrial water supplies overshadow lighter and seemingly less important contributions such as recreational centers to relax and return to the task of living with renewed vigor, the new playground created by Boca Reservoir on the Truckee Storage Reclamation project in California-Nevada has received little news attention.

Three miles long and one wide, the newly created lake promises to become one of the most attractive recreational centers of the entire region. Readily accessible, it is already attracting numerous visitors.

Even before the creation of Boca Reservoir the Little Truckee River was a favorite trout-fishing stream. Now, with fish propagation conditions vastly improved, fishing has increased still further in popularity. Boating has also increased. During the 1941 season 140 boats were used on the reservoir.

Plans are under way for establishing summer home, week-end, and, possibly, general camping sites. The setting for such uses is exceptional. Boca Reservoir has an immediate surrounding of beautiful mountain country with considerable natural vegetation and is more flanked by the Sierra Nevada Mountains.

There is a special advantage in connection with the recreational development in the Boca area. Scattered throughout the mountain area of California and Nevada are many places for specialized sports such as skiing. But for the many working people and their families who reside in the Reno and Sparks areas, or even at more easterly points, the more generally desirable combination of outdoor recreations is not available within distances consistent with the usual length of the workman's leisure periods, except at Boca.

Among local people the name Truckee Storage project is seldom used, Boca Dam being the designation which carries a meaning to all, whether farmer, businessman, sightseer, or sportsman. This is partly due to the fact that although nearly 30,000 acres are included as project lands no distribution system work was done. Construction was confined to Boca Dam and Reservoir for the creation of facilities for supplying supplemental water for an established area with an existing distribution system owned by private interests.

Boca Dam is located on the Little Truckee River less than half a mile from the confluence of that tributary with the Truckee River. By road the dam is about the same distance off United States 40 and is 27 miles west of Reno, Nev., and 7 miles east of Truckee, Calif.

Truckee Storage Reclamation project and other Truckee River water users depend almost entirely upon water resulting from snowfall in the higher mountains to the west for their irrigation, power generation on this stream, and domestic needs. Several natural lakes, of which Lake Tahoe is the most important, provide facilities for retaining a large portion of spring run-off water for later use, and for year-to-year carry-over storage and flood control. However, such seminatural facilities are alone inadequate to provide sufficient capacity for either seasonal or carry-over storage, to provide stream-flow regulation consistent with irrigation and power production requirements, or to reasonably well protect the downstream areas against flood damage.

The Truckee Storage project was initiated for the purpose of constructing an upstream reservoir to supplement existing facilities and to provide additional storage and stream flow regulation. Boca Reservoir was planned to operate in direct conformity with Lake Tahoe so that the greatest amount of upstream control might be had.

Preliminary investigations covered the Truckee River basin possibilities at an earlier date but after May 25, 1935, all field work was confined to the present Boca Dam and Reservoir area. George W. Condon Co. of Omaha, Nebr., submitted the low bid on the construction contract. Work began March 30, 1937, and the official date for commencement of construction was fixed as April 24, 1937. Contracted construction was completed August 23, 1939.

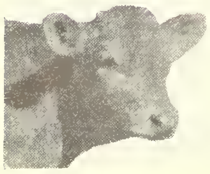
During the period of contract work C. C. C. forces and equipment were used to the extent possible on noncontract activities. After the completion of contract work a combination of Bureau of Reclamation and C. C .C. forces continued with all other work, including any that had in the meantime been eliminated from the original construction contract requirements.

Truckee Storage project water users are represented by the Washoe County Water Conservation District, a public corporation organized and operating under the laws of the State of Nevada and maintaining offices at Reno, Nev.

The district contracted for project construction repayment December 18, 1936, in 40 annual installments without interest except in certain cases of installment payment delinquencies.

A Splendid Stabilizer

on Northwest Irrigation Farms



THE DAIRY COW has contributed more than any other factor to the stability of irrigation farming in the Northwest, according to a committee on the Columbia Basin Joint Investigations which recently completely a study of eight irrigation projects comprising 14,000 farms and more than 500,000 acres.

The committee, investigating one of the 28 problems that the Bureau of Reclamation seeks to solve to help bring about the successful settlement of the area to be irrigated by Grand Coulee Dam, sought to learn what types of farm economy have been most successful on projects where conditions are similar to those likely to be encountered on the earlier units of the Columbia Basin area.

The Columbia Basin Reclamation project will be the largest irrigation development in the United States. Approximately 1,200,000 acres will furnish homes and a livelihood for 350,000 persons. Sound development requires a gradual introduction at the rate of 50,000 acres yearly. The first block of land is expected to be brought in 3 or 4 years from now when the pumping plant and necessary canals are constructed; other blocks will follow year by year. Prospective buyers of Columbia Basin land should get their information from the Bureau of Reclamation, free, and not risk possible fraud by land sharks now actively advertising farms.

Areas studied by the Joint Investigations Committee included the Vale project, Oregon; Owyhee project (new land only), Oregon and Idaho; Boise project (New York, Nampa-Meridian, Boise, Kuna, Wilder, and Black Canyon districts), Idaho; Minidoka project (Minidoka and Burley districts), Idaho; Yakima project (Kittitas, Tieton, Sunnyside, and Kennewick Highlands divisions); Franklin County District No. 1, Washington; Moses Lake Irrigation District, Washington; and Umatilla project (East Side Division), Oregon.

During periods of low farm income, many farmers turn to dairying as a quick and reliable source of additional revenue, it was found. Such low income periods may occur, first, when new settlers of modest means are becoming established on new land; second, when prices are low for all farm commodities; and, third, when the soil fertility of the farm has been materially reduced by overcropping.

Dairying, moreover, makes possible successful farming on areas where soil is poor.

By Dr. E. N. TORBERT
Field Coordinator

To quote a farmer interviewed by the Repayment Commission, "Things got so tough we had to go into the dairy business."

The importance of the dairy industry on the projects studied is shown by its growth during the past 15 years. On the Boise project, the number of dairy cattle per 100 acres in 1940 was 29 on the New York district, 27 on the Nampa-Meridian district, and 25 on the Boise-Kuna district. This represents an increase of 100 percent since 1926.

The Umatilla project, with 33 dairy cattle per 100 acres, has the highest proportional dairy population on the projects investigated, but the records show an increase of only 6 head per 100 acres since 1926. All of these districts have considerable areas of relatively poor soils, and dairying apparently is one of the few types of agriculture adapted to them.

The Yakima-Sunnyside district shows the greatest growth in the number of dairy cattle. They were increased from 8 head per 100 acres in 1913 to 22 in 1940. That farmers in this district may have adopted the dairy business in order to build up soil fertility is suggested by crop reports which show that alfalfa yield there dropped from 6 tons per acre in 1920 to 3 tons per acre in 1940. A considerable increase in lamb feeding and some increase in beef feeding during this period may have been made for the same reason.

On the three projects which have better soil, and on which there are fewer dairy cattle, a more stable relationship between crop area and dairy cattle has been maintained.

In the Minidoka project, the number of dairy cattle per 100 acres was 10 in 1926, and 9 in 1940. The Boise-Wilder had 7 dairy cattle per 100 acres in 1926 and 16 head in 1940. The Yakima-Kittitas shows the greatest change in this group, with an increase from 5 head per 100 acres in 1926 to 15 head in 1940. In addition to dairy cattle, there is a wide variety of other livestock on these projects, particularly sheep on the Minidoka and Boise-Wilder.

There was an average of 17 head of dairy cattle per 100 acres in 1940 on all projects investigated. In general, increase in dairy cattle has been gradual without indication of undue promotion or overexpansion. In reviewing this trend, it would seem possible that the dairy cattle population would continue a reasonable increase on these projects.

As a result of the study, the group found that the more successful types of farming combine crop and livestock programs, in which all forage and grain for livestock are grown on the farm, and the area in cash crops is limited to that which can be well fertilized with barnyard manure.

In a detailed investigation of 15 dairy farms (6 located on the Boise project, 6 on various divisions of the Yakima, 2 on the Minidoka, and 1 on the Owyhee project) the committee found many farmers raising hogs or keeping poultry, as a means of making profitable use of the skim milk. Raising clover seed is also a popular sideline.

The dairy farmers use over 60 percent of their land for alfalfa, pasture, and clover and keep an average of 41 animal units on their farm or one animal to every 2.2 acres. They placed 32 percent of their cropped area in hay, 25 percent in pasture, 28 percent in small grain, 4 percent in corn, 6 percent in clover, and 5 percent in other crops. The soil conservation practices of the dairymen are as good as or better than those of any other group considered. With a well-stocked farm these men are not dependent upon manure from outside sources, although some of them supplement barnyard manure with commercial fertilizer.

Rotation More Popular

Rotation pasture, a mixture of grasses and clover used as is alfalfa in a rotation plan, is growing in popularity. One progressive dairyman on the Minidoka-South has completed the first stage of a test of this type of pasture.

He is convinced that he can make more per acre by putting good cows (from 3 to 4 per acre) on high-producing pasture than by planting potatoes and beets. He plans to rotate his pastures by plowing them and putting in another crop whenever a significant amount of bluegrass appears.

Dairy farmers are also conservative in the number of enterprises they include in their programs. This type of farm has fewer enterprises than the other types studied, with the result that enterprises are generally large enough to make possible efficient management.

Trimotored

BUILDING and balancing the economy of the western half of this country is the job of trimotored reclamation, which provides food, power and water by means of multiple-purpose projects in the West. Food, power and water are the three "musts" of modern civilization. Irrigation farms, power plants and aqueducts built by reclamation engineers supply them. By stream regulation and water storage the Bureau of Reclamation is giving the West that solid balance of raw material and industrial production necessary for economic strength.

CITIES and towns created or supported by Reclamation number 279.

The Sculptures at Boulder Dam—Part II

A Split Second Petrified on the Face of the Universal Clock

By OSKAR J. W. HANSEN, *Sculptor*

Mr. Oskar J. W. Hansen, the sculptor, said in his report on his work with respect to the terrazzo star map and precessional diagram which forms the base plane of the monument at Boulder Dam:

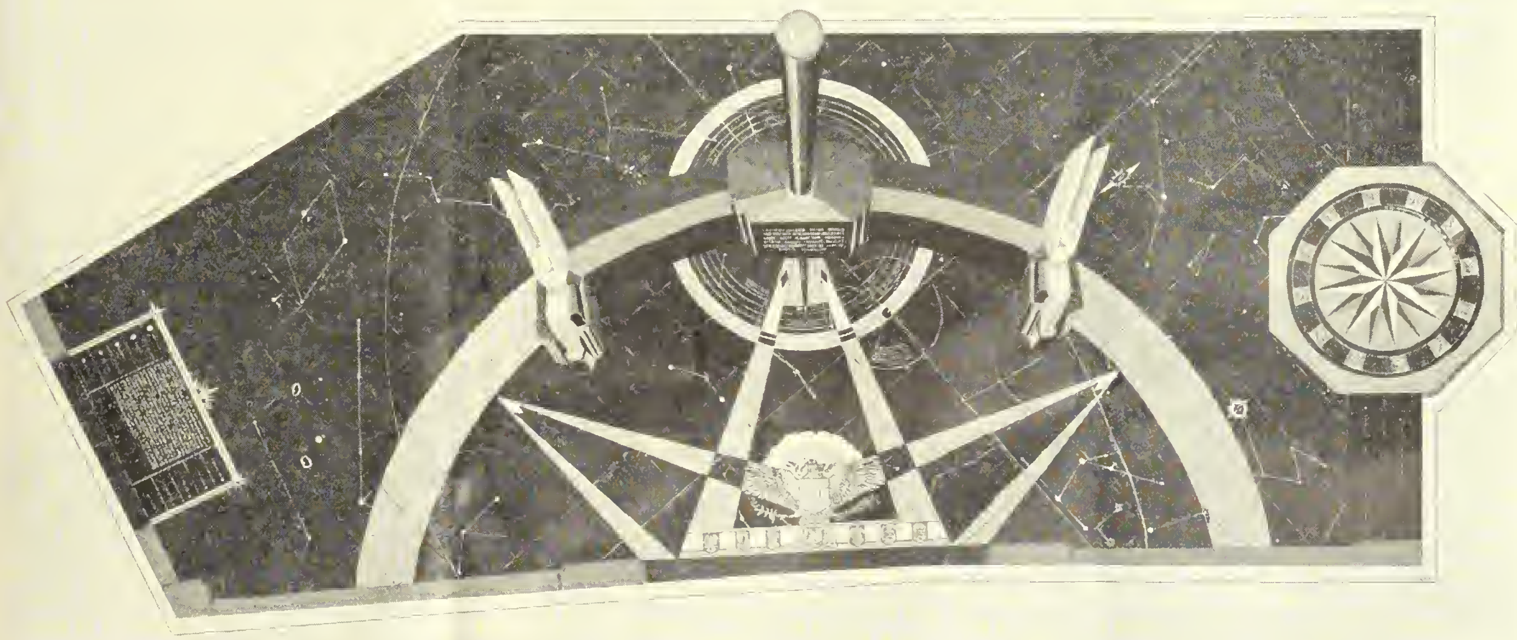
"I have been told that perhaps the public at large seek more concrete explanation, are lacking in understanding of the intangible values of life and that it may be better to speak to them in terms of tons of concrete and tons of bronze. If I had held the latter notion, it would have been dispelled by questions asked me by the public while I worked on this monument at the dam. I know from them that their wish to understand is great, their capacities unlimited.

"Man's control over natural forces has grown in proportion to his increasing knowledge of the true nature of this Universe of which we are a part. The external search with the telescope has immeasurably hastened our internal search with the microscope. Time, the intangible governor of all our acts, is measured to us by the external relations of our Earth to other worlds in space. Therefore, I thought it fitting to have the base of the monument rise from a finely wrought, marble terrazzo star map of the northern regions of the sky."

DAY BY DAY, and in remote ages to come, intelligent people may view the star map out of which rises the monument at Boulder Dam and from it learn that the astronomical time of the dam's dedication was in the year 1935 of Our Era, on September 30, and at 8:56, 2.25 seconds in the evening of that day, as calculated from the center of our Sun, or the center of the Ecliptic.

On this star map, the center of our Sun is shown as the very center of the flagpole. The positions of the stars shown on the map are then related in hour, minute, and right ascension from this center of the Ecliptic. The true obliquity of the North Pole of the Earth's Equator is shown in the same manner as of that split second of time mentioned in the previous paragraph. All information, relative to astronomical theories and facts, has been verified by the Naval Observatory, the Smithsonian Astrophysical Laboratory and by other reliable sources. People ordinarily indicate a star with a five-pointed symbol. Under a sufficiently powerful telescope each heavenly body would show a disk like that of our Sun or Moon. The star map on Boulder Dam shows a firmament of such brilliant disks. These Nickel-Silver disks are scaled to the exact diameter for the relative Apparent Magnitude of each star.

A legend has arisen to the effect that only five people understand the information given on this star map. While the number is not *so limited,* it is true that this map shows astronomical evidence which results from very obtuse mathematical calculations. It is not necessary that the average visitor should be able to solve, along with top-flight astronomers, their most difficult problems. Not one educated person in a thousand may know how to calculate true time or to navigate a ship; but almost everyone can read time from the dial of a watch. The precessional diagram which traces a *Platonic Year* about the center of our flagpole is in many ways similar to a watch dial. Let me first remind



Details taken from the star map

you how the Sun's family of planets are arranged about her in space.

Could we trolley home on Halley's Comet from some distant point of the Milky Way Galaxy, we would find our Sun's family appear very much like the familiar picture we know so well of Saturn and his rings. In the case of the solar system, the bright bands we could see extending out into space from the Sun's Equator, or in the main, along this Ecliptic Plane, would be made up from the Asteroids and other star dust debris. Our Earth would be seen to shine like a blue star sapphire while it passed in and out among these nebulous rings of solar star sweepings. The other planets would appear like faintly tinted diamonds of varying hue, as they followed the Sun within her sparkling diadem in space. Try to visualize this picture as I explain for you the nature of the celestial watch dial which is fitted around the flagpole base on Boulder Dam.

Instead of measuring 12 earthly hours this dial measures a *Platonic Year*. A *Platonic Year*, or *Great Year*, according to Stockwell, is made up of 25,694.8 of our ordinary years. We cannot be too sure of the exact length of the *Platonic Year*, because the civilized history of man and hence astronomy, is at the most only 10,000 years old; but we feel certain that it may not vary from the above mean time by more than 281.2 of our ordinary years. After a few thousand years, the people who come to see our huge watch dial on Boulder Dam will be able to tell by referring to our calculations whether we have set our celestial watch to run a split second too fast or too slowly.

We know that they will find our huge watch is *running down*. The nemesis of the Earth is her silvery Moon. The Moon causes our tides to rise as her gravitational pull acts, in unison with that of the Sun and her other planets, upon the equatorial masses of the swiftly rotating Earth. Since the Moon moves continually either up above or below the plane of the Ecliptic, her braking action on the Earth is very uneven and disconcerting. It causes the Earth to wobble as she spins on her axis. She nods approximately 2,800 times to and from the Sun during a *Platonic Year*. This tidal friction and consequent nodding causes her to lose time at the rate of almost 2 seconds per century.

At the end of a *Platonic Year*, our day would be longer by 8 minutes, more or less. This is not a lot of time, and you and I may not be here to count it, but it interests us just the same. It affects progressively the mean temperature on this Earth. The mean temperature controls precipitation and precipitation is of interest to the Reclamation Service and the world in general.

Finally, the day will get so long that it equals our year. The Moon will then again be a part of our Earth; mutual attraction will have made them one. The Earth will

Below: Mr. Hansen, the sculptor, at work on the star map

The Inscription on the Star Map

IMPORTANT STARS *and features of the Polar region of the sky as it appeared at 21:30 local apparent time on 30 September 1935, when this structure was dedicated, are shown by the diagram on this floor.*

The apparent magnitudes of the stars are measures of their relative brightness as estimated directly by the eye. By comparing the apparent magnitudes and considering the known distances to the stars, determinations have been made of the absolute magnitudes or the brightness the stars would display if they were a distance of 10 parsecs from the Earth.

The distances to the nearest heavenly bodies are measured by triangulation. A distance between two points on the Earth is used as a base line and very exact distances are then determined by measuring angles to such nearby objects as the Moon, Eros, and other asteroids. This provides a scale for measuring distances within our Solar system. It shows the mean distance to the Sun to be 92,900,000 miles. This is taken as the unit of measurement within the Solar system. Twice this value, the mean diameter of the Earth's orbit about the Sun, is a new base line, which permits direct measurements, subject to diminishing accuracy as the distances increase, to be made to stars within 50 parsecs. When the angle at a star subtended by the mean semidiameter of the Earth's orbit is one second of arc the star is one parsec distant.

The sidereal year is now 365.256360 mean Solar days; 3.258 sidereal years are required for light to travel one parsec at the rate of 186,300 miles per second. Our Sun has an absolute magnitude of +4.9; the most luminous star, S. Doradus, a value of −8.9 (320,000 times as bright as our Sun); and the least luminous star, Wolf, 359, a value of +16.5 (1/50,000 the brightness of our Sun).

The distances to the vast majority of the stars are beyond 50 parsecs and must be measured indirectly. By a careful spectroscopic study of the intensity and spectrum pattern of a star's light, its approximate absolute magnitude can be determined. When this absolute magnitude is compared with the apparent magnitude, the distance to a star as faint as the twelfth apparent magnitude may be determined. Spectroscopic study of a star's light discloses also the temperature of the star, its total radiation when its distance is known, and permits the determination of its linear diameter. By analyzing the dynamics of double star systems or binaries, the masses of certain types of stars may be determined, and a study of the problem of the interior conditions of the stars can be undertaken.

The known relation between the period of variation and the absolute magnitude of Cepheid Variables furnishes another method for more distant measurements. Stars like these have been studied in galaxies far beyond our own Galaxy or Milky Way.

The prism and grating of the spectroscope separates light into its component colors and the light patterns in the spectrum tell the physical and chemical nature of the light source. If these patterns are shifted toward the blue, the light source is approaching. If the shift is toward the red, the light source is receding. Thus the radial velocities of stellar bodies within our system may be determined. By considering these radial velocities and the relative cross motion of faint stars, it has been determinedd that the center of Our Galaxy, or Milky Way, is roughly 10,000 parsecs distant, and the time require for the sun to complete a circuit around this center is in the order of 200,000,000 years.

This dam is a major structure of our times. That astronomical date line of the day of its dedication, imparted to future times by this monument and star diagram, is established in consequence of these theories, facts, and conclusions.

When, in the course of time, the composition of our world and those other worlds in space shall be more fully known, record it here for future men to see . . . and, having seen, to speculate, investigate, and carry on the search.

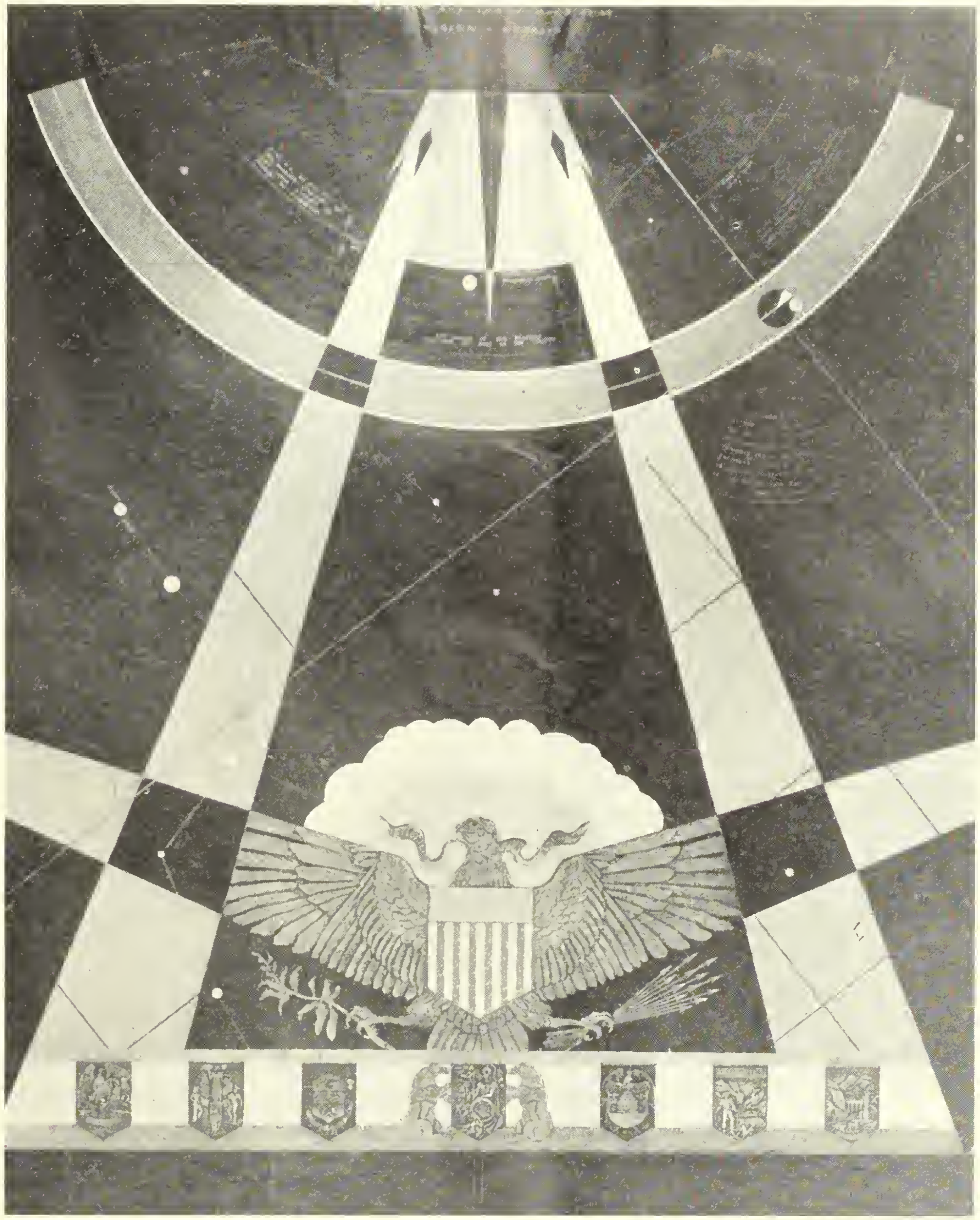
then present but one glowing face to the Sun; while on her other side darkness will be forever "upon the face of the deep."

If man could adapt himself for life under such conditions, he would be found in the zone of eternal twilight which will rim the Earth in between these temperature extremes. It is not likely that he will be present, though. The quantity of oxygen will be negligible, if not nonexistent. Our atmosphere will have dissolved and with it all green and living things familiar to us. The Earth will move, a barren hulk in space and her face will be pitted from continuous collisions with meteoric debris. We need not worry about this coming event but its eventual progress may interest even us. Our watch dial and observations to be made in the future and then referred back to the needle point which we show at the intersection of the Meridians, would show our visitors from century to century if our watch is *running down at the same uniformly slow rate*. They would simply observe if the North Pole of the Earth's Equator continues to nod to and fro within the limits of the yellow band around our flagpole.

I made the Diorite base of the monument describe an arc through the central field of this celestial watch dial. The whole composition is faced toward the arc of the dam and is arranged so the portion of the *Platonic Year which records the early dawn and continued human history* comes directly in the front and center of the monument.

In reality, there is shown both the end and the beginning of a *Platonic Year*. The Meridians, which serve as watch hands on our dial, intersected where the image of a Pyramid is shown in that, to us, ancient day when Thuban, the Biblical *Star of Egypt*, gave the direction, North, to the children of Israel by the fleshpots of Egypt. Centuries later, the Egyptian priests were to show to Herodotus the coming signs of a *Platonic New Year*.

This prediction was fulfilled in the year 0 of Our Era, when Christ was Incarnated and the Sun passed the Meridian of her Zodiac at 11 degrees West of Greenwich and the Aquarian Age of Man began. Further on, is found the black circle with a white wedge which indicates the diurnal rotation of the Earth on the day of the Dam's dedication. By comparing the segments which these events cut from the whole circle of the *Platonic Year*, we note that history is brief and that humanity is treading with uncertain, emotional steps the paths of youth in springtime.



Let me mention a few other interesting features of this star map, such as: Andromeda, Nebular Universe closest to our own Galaxy, the North Pole and Equator of our Milky Way Universe, a compass which indicates the North of the Earth's Magnetic Field, the bronze bas-reliefs which depict the ancient Signs of the Zodiac, the Apex of the Sun's way in space and an inscription which gives a brief of the methods man follows in his search within the incredible distances of space and some of the results he gleans by that search. The end of this brief is a plea to future peoples to carry on and build for future minds, knowledge concerning the true nature of our own and of those other worlds in space.

Above: Precessional diagram and decorations directly in front of monument. *Left:* The compass at the left of the monument makes a pleasing pattern viewed from above. Arranged about it are the 12 signs of the Zodiac. The inscription is: To the magnetic pole of the Earth. *Below:* Details of three of the placques around the compass

Reclamation Acreage Gains

610,000 Acres Added in Decade

THE BUREAU of Reclamation provided irrigation in 1939 for 610,216 more acres than it was serving in 1929, according to a preliminary tabulation of the Census of Irrigation for 1940 introduced in evidence in the hearing of the Tri-State case involving the waters of the North Platte River in December. The hearing was at Denver, Colo., before a master appointed by the Supreme Court of the United States.

Of the increased area served by the Bureau of Reclamation 338,976 acres were in new land and 271,240 acres inadequately irrigated by other systems were served supplemental water.

Projects under the Office of Indian Affairs showed an increase in the area irrigated from 1929 to 1939 of 174,806 acres.

The preliminary tabulation, which is subject to revision and corrections, showed the total area irrigated (both Federal and non-Federal) in the 17 Western States to have increased in 10 years by 1,624,097 acres or from 18,944,856 to 20,568,953 acres. Fourteen States showed increases and three—Utah, Colorado, and South Dakota—reported decreases in areas actually irrigated.

Acreage irrigated by Federal projects (primary or full supply) actually in operation, 1929 and 1939, in the 17 Western States

[Area irrigated, in acres]

	Bureau of Reclamation		Indian Office		Total Federal		
	1929	1939	1929	1939	1929	1939	Gain
Arizona	278, 584	265, 042	13, 555	84, 183	292, 139	349, 225	57, 086
California	31, 998	44, 581	2, 908	4, 106	34, 906	48, 678	13, 774
Colorado	81, 883	83, 137	4, 813	6, 875	86, 696	90, 012	3, 316
Idaho	275, 954	344, 638	34, 991	34, 965	310, 945	379, 603	68, 658
Kansas							
Montana	98, 327	186, 002	75, 844	125, 021	174, 171	311, 023	136, 852
Nebraska	147, 026	160, 799			147, 026	160, 799	13, 773
Nevada	54, 040	57, 471	6, 148	17, 607	60, 188	75, 078	12, 890
New Mexico	103, 110	−98, 064	20, 824	26, 513	123, 934	124, 577	643
North Dakota	6, 089	14, 131		147	6, 089	14, 278	8, 189
Oklahoma				334			
Oregon	61, 829	130, 403	4, 135	5, 168	65, 964	135, 571	69, 607
South Dakota	36, 193	−34, 222		815	36, 193	35, 037	−1, 156
Texas	65, 442	−61, 153			65, 442	61, 153	−4, 289
Utah	40, 000	−38, 623	54, 619	58, 594	94, 619	97, 217	2, 598
Washington	118, 667	167, 085	92, 367	118, 637	211, 034	285, 722	74, 688
Wyoming	85, 886	138, 653	21, 636	23, 681	107, 522	162, 334	54, 812
Total	1, 485, 028	1, 824, 004	331, 840	506, 646	1, 816, 868	2, 330, 650	513, 782

Bureau of Reclamation: gain, 338,976 acres; Indian Office: gain, 174,806 acres.
Source: U. S. Census of Irrigation, 1930, and Preliminary Census Tabulation of Irrigation Data, 1940.

Areas not in Government projects but irrigated with supplemental water supply by Bureau of Reclamation projects.

State	Irrigated, 1929	Irrigated, 1939
Arizona	68, 010	58, 044
California [1]	1, 700	1, 709
Colorado	15, 350	13, 074
Idaho	820, 570	842, 715
Nebraska [1]	91, 440	96, 602
Nevada		11, 874
Oregon [1]	33, 540	85, 042
Texas	60, 000	12, 681
Utah	7, 230	161, 455
Washington	124, 390	161, 876
Wyoming [1]	12, 000	15, 398
	[1] 1, 234, 230	[2] 1, 460, 470

Net gain: 271,240 acres from 1929 to 1939, exclusive of about 45,000 acres in New Mexico reported irrigated in 1929 by the Rio Grande project but not reported in 1939.

[1] Total reported by Bureau of Reclamation for 1929. Apportionment of interstate projects estimated.

Reported in Preliminary Tabulation, Census of Irrigation, 1940.

1,460,470 Acres Served by Bureau With Supplemental Water Supply

Of 3,265,042 irrigated acres which were supplied supplemental water in 1939, 1,460,470 acres were served by Reclamation projects.

The accompanying tables make comparisons by States of acreage data reported by the Census of Irrigation for 1930 and the preliminary tabulation of the 1940 census.

So far complete State reports of the Census of Irrigation have been issued only for the States of Nebraska, Colorado, and Wyoming. Difficulties in maintaining personnel due to defense and the draft have delayed completion of detailed tabulations for other States and completion of the irrigation reports for the entire country. In addition to the 17 Western States of Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming, separate irrigation reports will be issued for the States of Louisiana, Florida, and Arkansas.

Comparison of area irrigated in 1929 and 1939 in the 17 Western States as reported by Census of Irrigation, 1930 and 1940

	1929	1939	Gain
	Acres	*Acres*	
Arizona	575, 590	652, 806	77, 216
California	4, 746, 632	5, 177, 650	431, 018
Colorado	3, 393, 619	3, 220, 685	−172, 934
Idaho	2, 181, 250	2, 273, 949	92, 699
Kansas	71, 290	99, 980	28, 690
Montana	1, 594, 912	1, 696, 063	101, 151
Nebraska	532, 617	610, 379	77, 762
Nevada	486, 648	832, 253	345, 605
New Mexico	527, 033	553, 174	26, 141
North Dakota	9, 392	21, 615	12, 223
Oklahoma	1, 573	4, 160	2, 587
Oregon	898, 713	1, 048, 076	189, 363
South Dakota	67, 107	60, 198	−6, 909
Texas	798, 917	1, 040, 114	241, 197
Utah	1, 324, 125	1, 176, 239	−147, 886
Washington	499, 283	615, 114	115, 831
Wyoming	1, 236, 155	1, 486, 498	250, 343
Total	18, 944, 856	20, 568, 953	1, 624, 097

★ ★ ★

Grand Coulee Steel—From Dam to Ships

THE STEEL that helped build Grand Coulee Dam is now helping to build ships for Uncle Sam.

Heavy girders and other parts of the tall construction trestles over which Diesel-electric trains conveyed most of the 10,500,000 cubic yards of concrete in the big structure are being sold from time to time by Consolidated Builders, Inc., general contractor, to shipyards on the Pacific coast.

About 1,000 tons are in use in the ways of the Todd-California Shipbuilding Corporation at Oakland, Calif., and in the Oregon Shipbuilding Corporation yards at Portland, Oreg. Additional shipments will be made soon to the new eight-way plant Kaiser Co., Inc., has begun to construct at Vancouver, Wash.

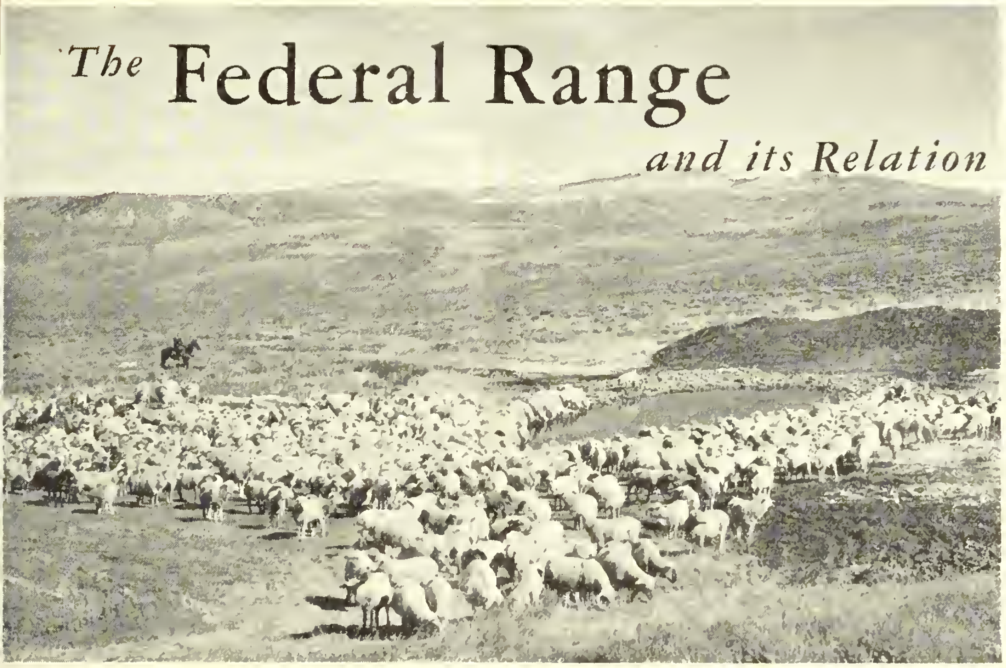
When mass concrete pouring was completed recently, Consolidated Builders, Inc., dismantled two-thirds of its trestle. The remaining section, on the east end of the dam, will be removed when no longer required in the construction of the right powerhouse.

The original span contained 9,600 tons of steel, 2,000 tons of it salvaged from an earlier trestle constructed by the Mason-Walsh-Atkinson-Kier Co. It was 3,600 feet long and carried four standard-gage tracks. When built, its highest bent was 210 feet above the base of the dam provided by the Mason-Walsh-Atkinson-Kier Co.

Previous to the erection of the Consolidated Builders, Inc., bridge, Mason-Walsh-Atkinson-Kier used a high and a low construction trestle, both with foundations on bedrock. One, averaging 95 feet in height and equipped with two standard-gage tracks, was used to pour the downstream portion of the base which could not be reached by the double-cantilever cranes stationed on the taller upstream trestle. The latter averaged 175 feet in height and carried three tracks.

Trestle "legs" were buried in the concrete as the dam grew.

The Federal Range and its Relation



By R. H. RUTLEDGE
Director of Grazing
Grazing Service
Department of the Interior

FORTY YEARS AGO Congress passed the original Reclamation Act to develop arid lands through irrigation. The impact of reclamation of such lands on both our western and national economy is so well known that the average citizen is inclined to view with complacency its significance in American history. Monumental dams are too often admired only for their beauty and engineering design. Power lines that crisscross the desert are taken for granted and thriving communities surrounded by rich green croplands are, to the average American, but natural sequences in the process of a Nation coming of age.

Eight years ago Congress passed the Taylor Grazing Act to protect and improve the public range and watersheds of the West and to stabilize the range livestock industry dependent on those lands through development of a sound national land-management policy centered in our public lands.

What is the relationship existing between these two great conservation acts? How are the problems of the range livestock industry related to those of adjacent irrigated farming communities? What effects do Grazing Service activities have on Reclamation Service activities in the Western States? Before attempting to answer these questions it seems worth while to examine briefly some of the outstanding factors that foreshadowed the need for Federal attention to land and water problems peculiar to the West.

The century-old policy of free and easy disposal of our public lands ended with the passage of the Taylor Grazing Act. During that 100-year period the public lands and their untold resources seemed to many an everlasting reservoir of new wealth; a boundless territory awaiting only the ax and the plow. In many respects the West has fulfilled these promises, but in the process there was a final awakening—a realization that our resources are not inexhaustible.

At first large areas were sold outright and the revenue was used for paying the running expenses of the Government, as well as for liquidating the public debt.

About 1840, with a balanced budget and a surplus in the Treasury, the need for cash sales had diminished. The ever-increasing westward expansion which led to the gold rush, the war with Mexico, and the Texas annexation, now seem but natural interruptions to the growth of a nation perfectly welded between two oceans.

The free homestead acts, the great cattle drives, and the transcontinental railroads linking the East with the West are but a few of the influences which gave rise to the ever-increasing migration westward. Thus, at the turn of the century, we had completed the discovery of the West, and, in the absence of adequate plans or policies on the part of the Federal Government, we were well on our way to full and wasteful exploitation of the rich discovery.

Disappointed Miners Become Farmers

In the early mining days food was not only a scarcity but certain foods, now commonplace in our diet, were luxuries. Enterprising prospectors and others, disappointed in their quest for gold, turned to farming along the watercourses and soon discovered a ready market at the mining camps for all the food they could raise. Meat and dairy products brought fabulous prices. There followed the development of large valley areas, irrigated by natural flow, and the attendant controversies, court decrees, and ultimate State laws involving the protection of water rights. Stock ranches were developed on a scale commensurate with the ability or desire of the rancher to use the outlying ranges. Although, as a whole, these ranches served only as a base for range operations, there was established a fundamental relationship between ranch and range which has endured through the years.

In the present emergency, the requirements of the United States for increased quantities of certain classes and kinds of livestock and livestock products will be met, insofar as possible through employment of improved methods of range management, through the obtaining of a greater "turn-off" of beef, or lamb, or wool, per animal unit of stocking, rather than as in the past through an increase in livestock numbers alone.

In 1939, in the United States, the income from livestock and livestock products exceeded the cash returns from all other agricultural crops combined by three-quarters of a billion dollars. In the Western States, alone, are raised nearly one-half of all the lambs and wool produced in the entire country and about one-fourth of the cattle. Of this number more than 11 million head of stock are run, during part of the year, on grazing district lands adjacent to Reclamation projects. A great many of the 20,000 odd licensees and permittees conduct their farming and feeding operations on project lands.

Today, the stockmen themselves and the trained personnel of the Grazing Service are giving serious consideration to the questions of both principle and practice involved in determining what degree of use of forage resources on any given area of range will yield the best results in terms of pounds of livestock marketed, as well as in terms of maintenance of the range on what might be called a "sustained-yield" basis. The immediate needs of the range livestock industry for forage and water are being weighed against the present needs for dependable water supplies for agricultural, industrial, and community uses; also, they are weighed against the long-time needs of the Nation for maximum production of essential food products with a minimum drain on the basis resources—soil, water, and forage. It is realized increasingly that a balance must be struck between upstream and downstream engineering and management in order to derive the greatest public benefit from these vital resources.

The transcontinental railroads, not only opened up the West to large-scale settlement but also, for the first time, provided a means of transporting the products of the western ranges to eastern markets. Free and unrestricted use of the range, unlimited competition for grass, and the prospect of quick profits from livestock, all were factors contributing to overloading the range to a point

From stockyard to market

far in excess of its ability to support the increased numbers. Eastern markets, in turn, were unable to absorb them at prices remunerative to the producers after a payment of freight and handling charges.

In less than a generation untold damage was done to millions of acres of public domain. The subsequent period of several decades of more moderate, but still unregulated use of the public grazing lands, was followed by a relatively short, intensive period of speculation in livestock during and immediately following the First World War. High prices, followed later by prices so low that operators were discouraged from marketing their livestock, resulted in further overstocking of range lands throughout the West.

Abuse and misuse of the range, which reached a climax during and immediately following the First World War, cannot with fairness be charged entirely to the stockman. Such practices as unseasonable use, concentrating around water holes, and other abusive methods did not occur because the substantial livestock operator did not understand the need for sound methods of range management. They occurred because of the natural human tendency for self-preservation fostered to a large degree by the absence of adequate authority governing the use of the public lands. The natural thing happened. Competitive methods and ruthless practices developed between the owners of flocks and herds. Under such conditions the operator usually succeeded best who got there first with the largest number of stock.

The crash of 1929 was followed by the lowest livestock prices in almost half a century. Overextension of the industry as a whole, combined with the effects of the widespread drouth of the early 1930's all but completed demoralization of an industry already hard hit by ruinous price levels.

Thus the stage was set for public attention and a demand for some sort of management of the public domain under law. Congressional recognition of this need was expressed in the Taylor Grazing Act of 1934.

There followed a number of conservation acts, such as the act of April 27, 1935 (49 Stat. 163), which recognized soil erosion as a menace to the national welfare. Thus, instead of a Nation bent on discovery and exploitation of resources, we are now firmly launched on a new field of pioneering. We are enlisted in a campaign for making the most of what we have. The past decade, perhaps, will go down in United States history as the turning point in public attitude toward our national resources. Events that history is now recording will show to American posterity that, after due and careful thought following the aftermath of the First World War, which was characterized by a decade of exploitation during the twenties, America's institutions of Government and learning had not completely failed them. Events of the decade just closed indicate a swing in the balance toward conservation as a whole as opposed to the one all-powerful enemy—waste.

As a logical step in welding the whole western conservation effort, President Roosevelt in his Fourth Reorganization Plan of April 11, 1940, transferred certain functions relating to soil and moisture conservation on Interior Department lands from the Department of Agriculture to the Department of the Interior, this transfer confirming the principle that such functions are the responsibility of the agency administering the land. Following this transfer, the Office of Land Utilization of the Department of the Interior allotted to the Grazing Service funds and equipment with which to fulfill prior obligations of the Soil Conservation Service within the boundaries of grazing districts and to coordinate soil and moisture conservation efforts throughout the Federal range. This program is implemented through application of proper range management principles in conjunction with a planned program of range protection and development.

57 Grazing Districts Established

The principal aims of the Taylor Grazing Act are to protect and develop the natural resources and stabilize the livestock industry through control and orderly use of the range. Stated another way, these aims propose a maximum use of the forage crop consistent with the conservation of soil, water, wildlife, and other natural resources. Under this law the Secretary of the Interior is authorized to establish grazing districts, after a local hearing, in each case. Grazing districts may include not more than a total of 142,000,000 acres of vacant, unreserved unappropriate public domain. The Grazing Service is charged with the administration of the law affecting grazing districts. To date 57 grazing districts, containing nearly 137,000,000 acres of such lands, have been established in 10 Western States.[1] These grazing districts cover a gross area of about 266,000,000 acres including State and private land, as well as large areas of other public land, specifically set aside for power, reclamation, military reservations, bombing ranges, naval oil shale reserves, and many other public purposes. Many of the Nation's outstanding Reclamation projects and thousands of irrigated ranches are situated within the boundaries of grazing districts.

Of the areas in prior withdrawals, the Grazing Service administers about 8,500,000 acres in connection with its range conservation program under appropriate agreement. Also, there is administered, under the Pierce Act of 1938, about 750,000 acres of State and county land, bringing the Federal range [2] area to about 145,000,000 acres.

Through cooperation with the local district advisory boards, with States, associations, individuals, and other Federal agencies concerned, the Grazing Service has full benefit of information, comments, and suggestions regarding economic, physical, and local conditions in the Federal range territory. Furthermore, it is equipped to pilot suggestions of merit on questions that pertain to range and watershed management on through to the desired action.

Complete decentralization of the Grazing Service to the scene of its activities was effected during the summer of 1941 by the establishment of the Director's office at Salt Lake City, Utah, in the heart of the Federal range.

A recent cooperative agreement entered into between the Grazing Service and the Bureau of Reclamation provides that undeveloped public lands withdrawn for Reclamation purposes may be administered by the Grazing Service for grazing purposes pending the time they are put to the higher use for which they were originally withdrawn. Under the terms of this agreement millions of acres of undeveloped Reclamation lands may be included in the general range management program. Already some 450,000 acres of such lands in eight States are being handled under this agreement. These receive protection and management similar to that accorded the other public lands in grazing districts. Grazing fees earned by these lands are collected by the Grazing Service and transferred to the Bureau of Reclamation for use of that bureau under its organic act.

Reclamation engineers are, of necessity, vitally concerned in determining not only the amount, duration, and seasonal flow of water that will enter any given reservoir, but, also, they are interested in the probable silt con-

[1] No grazing districts have been set up in the State of Washington.

[2] "Federal Range," as defined in the Federal Range Code, means land owned, leased, or otherwise controlled by the United States and administered by the Grazing Service.

tent of the water over a period of years. Since the life of any given reservoir is determined, in part at least, by the length of time it will take such a reservoir to fill up with silt, the cost of silt removal must be weighed with the problems of silt control and even with the probable cost of building a new reservoir.

The silt content of any given stream is governed by a number of factors, not the least of which are volume and velocity of flow. A good stand of forage on a watershed area has both a controlling and a stabilizing effect on the stream flow produced from such an area. The stems of grasses and forage plants act as a myriad of tiny dams in obstructing the flow of surface water and, by retarding its flow, make it possible for it to penetrate the soil more easily. Decaying organic matter serves as a sponge in absorbing water. The dead roots of grasses and other plants form channels that allow the surface water to soak more readily into the ground. As a general rule a healthy growth of forage promotes porosity of the soil, which, in turn (depending on a number of factors), tends to reduce or at least retard run-off, resulting in clearer streams on our watersheds. Range conservation, therefore, must be recognized as a dominant factor in an over-all program for soil and moisture conservation.

Good Range Management

Wise or unwise range practices on watershed areas may prolong or reduce the life of a reservoir downstream. The usually relatively minor loss in water ultimately delivered to the reservoir as a result of improved methods of range management and conservation is very generally considered to be more than offset by the advantages accruing to Reclamation projects in longer life, reduced cost of upkeep, and other benefits.

Good range management employs all the accepted principles of soil and watershed conservation. It includes the regulation of range use as to season, numbers and kinds of livestock, a planned program of range development and constant efforts to combat and eliminate destructive elements such as rodents, predatory animals, range fires, noxious weeds, poisonous plants, and insect pests.

Types of range improvements include the development of springs and seeps, the construction of small reservoirs, stock tanks, and wells for watering livestock; the reseeding or revegetation of barren or depleted areas; contour-furrowing and water-spreading devices, and structures designed to minimize soil and water losses. All of this "upstream engineering" has a direct influence in the control of flowing water needed in the valleys for irrigation and power.

Stock and truck trails, bridges, cattle guards, fences, and corrals are built on the Federal range to facilitate range operations and management. Radio and telephone facilities for fire protection and administrative work are also installed where needed.

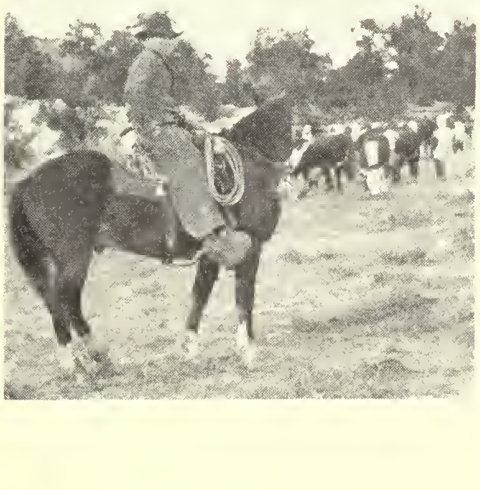
The conservation of upstream areas of Federal range has also both direct and indirect effects on the economy of irrigated farming and ranching areas under the administration of the Bureau of Reclamation. A great many of the farmers on Reclamation projects depend in part on income from cash crops and in part on income from livestock operations of their own. Seasonal use of the Federal range is of vital importance in the success of such farmers. Improved, well managed ranges result in more and better forage and better livestock weights which means additional income to farmers and ranchers who run livestock during part of the year on the Federal range.

Many project farmers specialize on cash crops such as sugar beets, lettuce, tomatoes, beans, celery, and other produce. These practices are dictated in part by soil, climatic, marketing, and other factors peculiar to the locality. To get the most out of their lands over a period of years, many of these farmers have found it necessary in certain localities to follow a system of crop rotation, alternating the planting of specialized crops with grain or alfalfa and other legumes. In many cases also, to give the land a "breathing spell," they have found it advisable to put such land into irrigated pasture or hay land for a year or two. For such crops there is usually a ready, local market.

The range livestock industry is the logical purchaser and user of feed crops grown on the irrigated lands of Reclamation projects and, in certain areas, it has been found that the income from rental of aftermath pasture and hay lands to livestock operators has been sufficient to pay the taxes on such lands. Fertility added by such pasturing of livestock on farm lands for a month or two each year is also of value to farm owners.

In many instances project farmers buy "stockers" or "feeders" at the proper season and thus market their surplus crops and aftermath. In some localities the irrigated lands are "custom-pastured," as the practice is coming to be called in certain sections, at fixed rates per head per month. Under this system, cattle or sheep are placed on aftermath pasture, irrigated pasture, hay, or unharvested feed crops. The livestock thus both "harvest" and "market" the farm produce. The practice in general of "custom-pasturing" of irrigated farm lands appears to be increasing because it affords both the farmers and stockmen concerned a means of obtaining additional income through this type of cooperative effort. Newly developing neighborhood packing plants, located at convenient points throughout the Western States, are already beginning to provide outlets for an increasing number of pasture-conditioned or grass-fattened stock.

Weaver calves on the trail, from summer range to shipping point

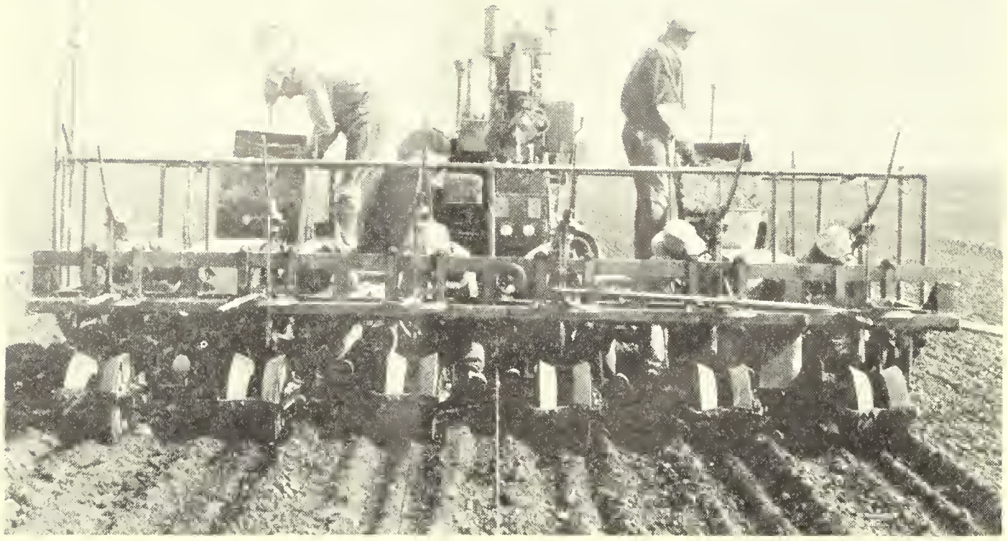


The interdependency of livestock operators having range stock to sell or to condition for market, and of farmers in irrigated areas having aftermath pasture or other feed to sell, is slowly but surely bringing into existence a balance between the farm and the range. The range livestockman and the project farmer are being brought into a constantly closer relationship to the mutual advantage of each.

The range livestock industry in the semiarid and arid regions of our Western States might, eventually, have all but destroyed itself, if the original conditions of "cut-throat" competition for grass and water had been permitted to continue indefinitely. In fact, certain areas in the range country were being compared with lands in Greece, Palestine, Arabia, and parts of China, where hugh areas of once fertile lands are now barren waste. Eventually, those areas were practically abandoned because the vegetation, the soil, the springs, and the streams had all but disappeared.

In the United States there is no necessity of duplicating any such situation as that which is commonly known to have existed for centuries in parts of Asia and the Near East. Our people have at last been aroused to the need for conservation and wise use of our land. Today the principles and effects of sound management and conservation methods are too well known and understood to permit the abuse or waste of our soil, water, and forage resources.

How well we, as a self-governing people, succeed in a long-range program for beneficial use of our resources can be gaged by how well and effectively range users, water users, other citizens, and the responsible agencies cooperate. There must be an appeal to the intelligent understanding of present users and we all must view our needs and the needs of the Nation, not only for present, but also for future generations. This appeal can be carried to the farmers, the stockmen, the industrial and other interests through the opportunities for teamwork that are inherent in the activities of the Reclamation Service and the Grazing Service.



Six-row planter capable of planting 15 acres of guayule shrubs per day. Ten men are needed to run this machine

Rubber from the Desert

By A. B. WEST
Economic Analyst

GUAYULE is a rubber-bearing plant indigenous to southwest Texas and northern Mexico. Before the advent of tire rationing last December it was an almost totally foreign word to the average citizen. Today that citizen is learning that war needs and retread stock for his own tires, if he is eligible, may have to come in part at least from domestic production of this unimpressive looking shrub.

The country's need for rubber to keep war wheels moving and civilian life functioning is estimated at 800,000 long tons a year. Present stocks are placed at 600,000 long tons. Imports now are a question mark, and we face the unhappy prospect of losing completely our main supply of crude plantation tree rubber. In the meantime our needs can be met scantily for the next 3 years by conservation of imported crude, greater use of reclaimed rubber, and increased production of synthetic rubber. But there is an end to this. Our reservoir of reclaimed rubber will become exhausted, our imported crude will melt away under the demands of the expanding war industries, and synthetic rubber alone does not make good tires or good tank treads.

Some source of natural crude must be found. Guayule offers the brightest hope. Together with what tree rubber can be gotten from South America and Africa, it can be made to meet the emergency.

Guayule has been used for producing rubber commercially on a small scale since the early 1900's. In 1912 it was brought to the Salinas Valley in Monterey County, California, by the American Producer's Division of the Inter-Continental Rubber Co., and experimental work was begun in building up a highly productive strain from the desert varieties.

The cultivation of guayule as a domesticated plant has not been accomplished easily. By painstaking effort the stunted, slow growing wild shrub requiring 15 to 20 years to reach a size economical for marketing has been evolved into a plant capable of withstanding close cultivation under forced growth, and yielding about 1,250 pounds of rubber per acre in 4 years' time.

The accompanying table compiled by the Inter-Continental Rubber Co. is based on its experience at its Salinas, Calif., experiment station. It estimates the acreage required to yield 10,000 tons of the dry shrub annually for each year of a projected 10-year period. It should be noted that the cost per pound stabilizes at 11.3 cents the seventh year, but that reasonably efficient production is reached the fourth year. The yield per acre starts at 90 pounds the first year, almost quadruples the second, and by successive increments reaches 3,195 pounds the tenth year.

The Salinas growers have developed a very efficient routine of planting and harvesting guayule, much of which is accomplished by specially designed machinery of proven quality. The seeds are presprouted and planted in nursery beds supplied with overhead irrigation. Planting is done entirely by a machine which automatically spreads the seed, rolls the seed bed, and covers it with a thin layer of sand. Frequent irrigations nurse the tender plants along, and in 10 to 12 months the seedlings are dug out by a power-drawn cutter blade, sorted, and transported to the field, 5,000 in a box. Here they are placed in a planter and transplanted six rows at a time. No irrigation is required in field culture of guayule in the Salinas valley, due to the cool, wet winters and summer fogs.

Irrigation Required for Guayule

In the Southwest and in the interior of California, irrigation would be required the first year, and probably the second, third, and fourth, though in lesser amounts. The first year water duty is slightly less than required for cotton. Water must be completely cut off in the hot weather after the first year, or the plant grows in stature instead of accumulating rubber in the roots and branches of the first year's growth, about 20 inches in height. Mature plants rarely exceed 30 inches. Seed is produced prolifically when water is supplied, but reduced in amount when the plants are deprived of water to hasten the formation of rubber.

The plants are harvested by plowing up the rows two at a time and throwing them together in a windrow. These small windrows are combined to larger ones, and picked up by a machine which chops the plants and loads them on a truck. The chopped mass is put through a mill that macerates it, and the rubber is skimmed off through a flotation process.

The rubber at this stage contains from 16 to 20 percent resin and must be treated to remove it. The deresinated rubber compares very favorably with imported crude from the Far East. Although the cost of deresinating is estimated to amount to $60 a short ton, it is largely repaid in the value of the resin byproduct.

Tire manufacturers have used deresinated guayule rubber for many years, purchased in

Young guayule rubber plants growing in the field

Mexico and from the Salinas growers. If production costs could be lowered to permit economic competition with plantation rubber in normal times it could be used exclusively.

285,000 Long Tons Possible Annually

It is probable that guayule will be harvested after 4 years' growth in the field, and that to make a realistic contribution as crude rubber to be mixed with synthetic at least 2,000,000 acres will be required. This acreage, harvested at the rate of 500,000 acres annually would yield approximately 285,000 long tons a year.

It is estimated that not over 100,000 acres of suitable unirrigated land can be obtained along the coastal valleys of California, and that the remainder of the land needed under a 2,000,000-acre guayule program would have to be irrigated. Little hope is held for inland unirrigated plantings, for although the guayule shrub grows wild under semiarid and arid conditions that seem to resemble a great area of the West, it cannot compete in hardiness with sagebrush, greasewood, and other desert plants. It is very selective in its choice of native habitat, growing best on slopes of rocky ridges where the soil is leached and composed chiefly of deteriorating limestone.

The Department of Agriculture is expected to receive congressional sanction to undertake a rubber plant program to "make available a domestic source of crude rubber for emergency and defense uses." An initial planting of all available seed will be made in nursery beds as rapidly as facilities can be expanded. Although the present law restricts plantings to 75,000 acres, that acreage represents more of a goal than a restriction. Field plantings of 2,000 acres will be made this spring from nursery seedlings on hand, and the acreage expanded as rapidly as possible.

The place of the Bureau of Reclamation in the guayule program has not yet crystallized. It is certain, however, that if almost 2,000,000 acres of irrigated land in the Southwest and inland California are made available for guayule, the Bureau's projects can help. To promote the most rapid expansion in acreage and obtain an estimated yield of 43,000 long tons of crude guayule rubber by the end of 1946, the 75,000 acres now authorized must be planted in field culture in the spring of 1943. Thereafter annual field plantings of 500,000 acres, on irrigated land, must be made if 285,000 long tons of guayule rubber are to be ready for the factories in 1947 and each year thereafter.

Gila's Yuma Mesa May Grow Guayule

Consideration is being given to the suitability for guayule on the Yuma Mesa unit of the Gila project and the East Mesa unit of the All-American Canal project. Among the factors that must be taken into account under a 4-year plan of culture are: Ample water the first year, and sufficient water as needed during the ensuing 3 years; hot, dry summers that will permit growth functions to become dormant, hastening the deposition of rubber in roots and branches; minimum winter temperatures of not less than 20° F.; and availability of public lands or leaseholds on private land.

Under a plan calling for harvest at the end of the fourth year income would be deferred 4 years, and private farming enterprise would have to receive annual advance payments to cover the costs of operation and land rental. Public ownership would therefore simplify the administrative details.

The planting of 2,000,000 acres of guayule on irrigated land in California and the Southwest would call for development of new projects, or hastening of those under construction now. Serious dislocation of the agricultural economy of the West established on the present irrigated area of 20,570,000 acres would follow the permanent displacement of food and feed producing acreage with guayule. The contribution of irrigated land to the Food for Freedom program would be materially lessened by even a temporary displacement.

Thus, the rubber crisis again emphasizes the value of irrigated land in the West, and for a use that few people foresaw. Irrigated land is a dependable ally, in peace or in war.

Guayule nursery beds, 3 months after sown. Inset shows mature plant

Guayule rubber production data based on experience of the Intercontinental Rubber Co., Salinas, Calif., using an extraction unit of 10,000 tons of dry shrub per year

	Field age of harvested shrubs, in years									
	1	2	3	4	5	6	7	8	9	10
Dry shrub harvested per acre, short tons	0.75	1.78	2.87	3.82	4.68	5.43	6.12	6.79	7.40	7.99
Required to yield 10,000 tons of shrub in 1 year, acres	13,333	5,618	3,484	2,618	2,137	1,842	1,634	1,473	1,351	1,252
Required for crop cycle, acres	13,333	11,236	10,452	10,472	10,685	11,052	11,438	11,784	12,159	12,252
Dry rubber extracted, percentage of shrub weight	6	9	13	16½	18	19¼	20	20	20	20
Annual production of dry rubber, short tons	600	900	1,300	1,650	1,800	1,925	2,000	2,000	2,000	2,000
Yield per acre, of dry rubber, pounds	90	320	746	1,260	1,825	2,090	2,448	2,715	2,960	3,195
Cost per pound of rubber, cents	81.6	35.2	20.2	14.5	12.9	11.8	11.3	11.3	11.3	11.3

The foregoing costs assume continuing operation of land and reasonable weed control. The excess cost (if any) of initial weed control for badly infested land is not included.

	Short tons
If 1 acre of guayule shrub were set out each year for 10 years, without harvesting, then at the end of 10 years the rubber reserve in the 10 acres of living shrub available for extraction would be 17,500 pounds or	8.75
If 10,000 acres were set out, the rubber reserve would be	87,500
And if 100,000 acres were set out, the rubber reserve would be	875,000

Source: Hearing before the Committee on Agriculture, House of Representatives, Seventy-seventh Congress, second session, on H. R. 6299, a bill "To provide for the planting of 75,000 acres of guayule or other rubber-bearing plants in order to make available a domestic source of crude rubber for emergency and defense uses," page 22.

THE WORLD'S LARGEST structure—as Grand Coulee Dam in Washington is called—weighs 21,867,425 tons. The dam and its appurtenant features contain 10,513,185 cubic yards of concrete. The Mason-Walsh-Atkinson-Kier Co. placed 4,525,209 cubic yards to provide the foundation and Consolidated Builders, Inc., poured the remaining 5,987,976 cubic yards. The first official bucket was unloaded on bedrock on December 6, 1935; the last mass pour to complete the dam was made last December 12, 6 years and 2 months later. Consolidated Builders established many new world's records on the dam. The maximum day's pour was made on May 25, 1939, when 20,684½ cubic yards were placed. The maximum 10-day period was October 11 to 20, 1939, when 174,960 cubic yards were placed. The best month was October 1939 with 536,264 yards produced. Yardages by years are as follows: 1935—14,351; 1936—1,846,481; 1937—2,664,377; 1938—866,220; 1939—3,686,362; 1940—1,375,609; and 1941—59,785. At the peak of construction operations 7,700 men were employed. In January 1941, the pay roll was 1,600.

Veterans Install Power

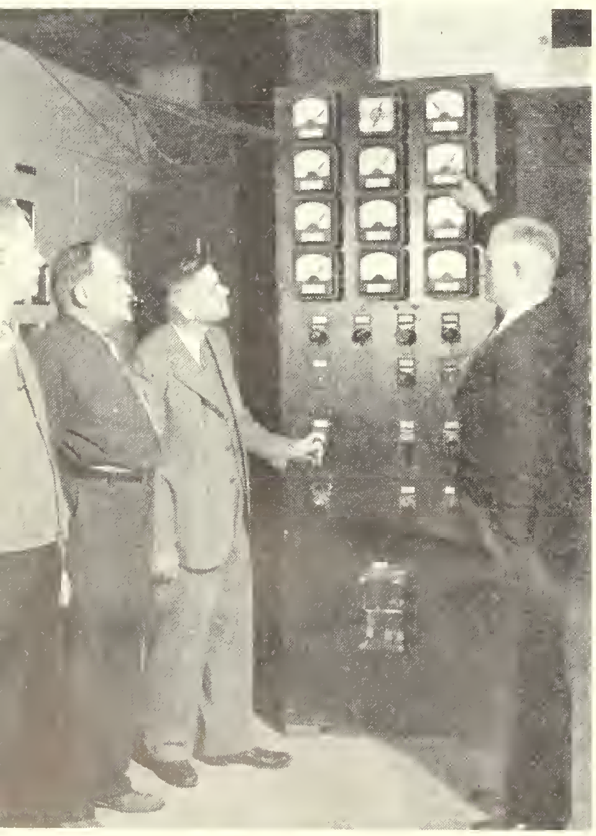
MEN OF EXPERIENCE, veterans in their fields, are in charge of the Grand Coulee Dam powerhouse installation.

Experience of the 4 erection engineers for the equipment manufacturers alone totals 107 years. There's H. Walter Berkley, erection superintendent for the Westinghouse Electric & Manufacturing Co., builders of the big generators, the world's largest hydroelectric machines. He has worked for the company 25 years, in Japan, China, Russia, Spain, Newfoundland, Mexico, and at Boulder Dam.

F. J. Malarkey, erection superintendent for the Newport News Shipbuilding & Drydock Co., holding contracts for six 150,000-horsepower turbines, helped the Russians at far-famed Dneiper Dam, the Canadians at Newfoundland, and the Americans at TVA dams at Muscle Shoals. His work record covers 33 years.

Dneiper Dam, Stalingrad, and Kashira, well-known points on the war map of Russia, Boulder Dam, and New York Power & Light were some of the stopping off places for J. A. Kadletz during his 28 years of employment

Reclamation officials look over L-3 generator. *Left to right:* Chief Electrical Inspector C. P. Christensen, Master Mechanic James A Wallace, Construction Engineer A. F. Darland, and Supervising Engineer Frank A. Banks



by the General Electric Co. He is in charge of the erection of 15 giant transformers, 3 of them physically the largest ever built.

Many of the largest dams in the United States, including Boulder on the Colorado River, Bonneville on the Columbia, and several TVA structures, have used governors built by the Woodward Governor Co. F. A. Smith, erection superintendent, with the company 21 years, helped install them.

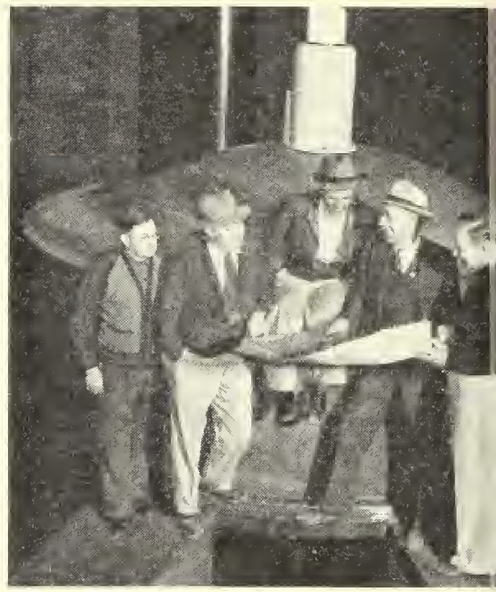
Bureau of Reclamation engineers also stack up an imposing experience record. The man under whose direction the Grand Coulee Dam and power plant was constructed is Frank A. Banks, supervising engineer. He has served the Government for 35 years, first joining the Reclamation Service on the Lower Yellowstone project in Montana. As designing engineer for the Idaho division, he drew preliminary plans for the Arrowrock Dam, for years the highest in the world. Later he had charge of the construction of the Jackson Lake Dam, the Minidoka project, the American Falls project and the Owyhee Dam, again the highest in the world at the time. Since 1933 he has been in charge of building the biggest dam in the world.

C. P. Christensen, chief electrical inspector for the Bureau, counts his working years back to 1911. He erected power machinery for the Great Western Power Co., of Sacramento, Calif., for Westinghouse, for the Southern California Edison Co., for the Metropolitan Water District of California, and for several smaller companies. He joined the Government force in 1934 at Boulder, where he had charge of generator installation.

Thirty-one years is the experience rating of James E. Wallace, the Bureau's master mechanic. He was with Allis Chalmers, Stone and Webster, Six Companies, and Babcock and Wilcox prior to joining the Bureau at Boulder in 1935 to supervise turbine assembly.

Close association with the growth of the city of Tacoma's fine municipal power plant, boasting some of the lowest electrical rates in the Nation, is prominently listed on the experience rating of A. F. Darland, construction engineer for the Bureau. At Grand Coulee he acts as a general overseer of things electrical and does a myriad of other work. He was also employed, his 27-year labor record shows, by the General Electric Co, and the Todd Drydock and Shipbuilding Corporation of Seattle. He joined the Bureau in 1934.

J. H. Miner, assistant supervising engineer, has 37 years of experience. He entered the employ of the Reclamation Service in 1904, was project manager of the Grand Valley and King Hill Carey Act projects. His ability was then used by the American International Shipbuilding Corporation and by Dwight P.



Installing $10,000,000 worth of equipment in left powerhouse. *Left to right:* Sam Fisher, Westinghouse Electric & Manufacturing Co.; F. J. Malarkey, Newport News Dry Dock & Shipbuilding Co.; H. W. Berkley, Westinghouse Electric & Manufacturing Co.; F. A. Smith, Woodward Governor Co.; and J. A. Kadletz, General Electric Co.

Robinson & Co. in connection with studies for hydro projects on the Hudson, Genesee, Santee, Des Moines, Ottawa, and St. Lawrence Rivers, with five dams in Brazil, and a 5½ mile subway in Buenos Aires, and by the United Engineers and Constructors, Inc., building a central heating plant and distribution system for 50 Government buildings in Washington, D. C. He returned to the Bureau of Reclamation on the Columbia Basin project in 1934.

★ ★ ★

WITH BIG generating units being installed at Grand Coulee Dam as fast as possible to supply power for industrial war wheels in the Northwest, oil tank cars will be a common sight at the dam for the next few years. A great quantity of oil is required by the power plant. The electric generating and distributing equipment when completely installed will require more than 1,650,000 gallons for its operation. The oil at the power plant will not be changed like that in an automobile, however, requiring replacement. Oil in transformers lasts indefinitely. That in the circuit breakers will merely be filtered once a year or so because the oil loses some of its insulatory strength. And the oil in the generators, even though it carries 800 tons of swiftly revolving steel shaft, will not be allowed to become heated and carbonize, nor will it collect harmful minute particles of metal thrown off by meshing gears in an automobile. It will be practically as good as new when run through a purifier every 10 years.

NEWS OF THE MONTH

Carey to Market CV Power

CHARLES E. CAREY has been appointed engineer in charge of marketing power on the Central Valley project. He was formerly chief consulting engineer for the Bonneville Power Administration, and also acted as Administrator, topping 20 years of executive engineering experience, a large portion of which was with the Westinghouse Electric & Manufacturing Co. Said Commissioner Page of the new Bureau engineer: ". . . excellently qualified." Said Bonneville Administrator Raver: ". . . with deep regret . . . I release (him)."

"FUN," Reclamation employees at Grand Coulee call their own special way of buying defense bonds. For each Jap plane shot down the men put a dime in a pot. As soon as $18.75 has been raised a drawing is held and the winner is awarded a $25 bond. Each of those contributing eventually wins a bond. Winning names are not returned to the pot until all participants have won, but each name must continue to donate a dime for each Jap plane downed until the round robin has been completed. Aside from this game, Bureau employees at the end of the year had also pledged $17,560 in bonds.

THE TREASURY has been repaid $16,200,000 of the cost of constructing the Boulder Canyon Reclamation project in Arizona-Nevada. Power revenue from Boulder Dam's plant accounted for most of the income.

HOW WE WILL GET our imported spices and medicinal herbs in the future is an important question raised by John Q. Consumer which may be answered by Reclamation farms in the West. Experimental plantings of these crops indicate success. On the Yakima (Wash.) project last year were grown pyrethrum, bergamot, pennyroyal, dill, coriander, paprika, edible soybeans, safflower, anise, caraway, fennel, cumin, ephedrine, devil's shoestring. Next year experimental plantings will be made with licorice, foxglove, canary seed, chervil, sage, tarragon, angelica, mustard, marjoram, camomile, rue, savory, tansy, wormwood, wormseed, erigeron or fleabone, belladonna, and thyme. Already commercially cultivated is peppermint.

PROMOTION of Clyde H. Spencer from resident to construction engineer on the Deschutes (Oreg.) project became effective February 1. Spencer had been acting construction engineer since the appointment of Deane S. Stuver as assistant general supervisor of operation and maintenance.

ONE OF THE AIRPORTS in the new Army bombardment group is to be constructed about 7 miles from Rapid City, Rapid Valley (S. Dak.) Reclamation water conservation project. It is expected that a personnel of 4,500 men and 450 officers will be moved in. Since the families of many of these men will live in Rapid City, the Rapid Valley project becomes increasingly important, as 7,000 acre-feet of water have been reserved to furnish the city with a domestic supply which will now be badly needed.

100 Trips Around the Earth

TWO and a half million miles of travel—the equivalent of 100 trips around the earth at the equator—probably makes W. H. Storey, of the General Electric Company, Grand Coulee Dam's "most traveled" visitor.

Storey is the car-tracer who acted as a "nurse-maid" for a recent 156-ton railroad shipment of the core and coils for the world's largest transformer from the factory to the Grand Coulee power plant.

Since 1917 this much-traveled visitor has been scurrying over all parts of the country to expedite the movement of company apparatus. He has visited every State in the Union and also Canada and Mexico. He has seen all but three or four principal cities of the United States.

The transportation of parts for Grand Coulee Dam's huge transformer proved somewhat more difficult than ordinary trips. In most cases, Storey just relaxes in a passenger train, disembarks at the railroad division points, confers with the superintendent or dispatcher, and makes certain the shipment is not delayed.

The core and coils for the transformer, however, were carried in a huge tank filled with nitrogen gas. The pressure of the gas prevents moist air from entering, and dampening the windings. Once every 24 hours whether it be night or day, 40 below or 120 in the shade, Storey checks the gas content.

Rapid fluctuations in temperature will greatly alter the amount of gas retained in the container. Heat will cause it to expand and escape, and cold will cause it to contract. In the latter instance, more must be added to bring the supply back to normal.

A BIG RETURN after some bad years is reported by Klamath (Oreg.-Calif.) project farmers for 1941, with an average crop and livestock yield of more than $94 an acre. Best immediately preceding year was in 1936 with an average acre return of $77.

WATER USERS took over the operation and maintenance of the Truckee Storage project (Nevada-California) January 15.

WELL EQUIPPED for any emergency is this Reclamation project guard with his automatic rifle, high-powered spotlight and holstered revolver. His job of protecting great

Reclamation dams like Grand Coulee, Boulder, and Shasta does not interfere with legitimate visiting by American tourists, however. Both Grand Coulee and Shasta Dams are under heavy guard but the visitors' view houses are wide open, continuing to offer the same thrill of seeing the country's most spectacular engineering works—and hearing guide lectures on how they were built and what they do—that a million or so people saw and heard last year. At Boulder Dam, even though the power plant is closed and the visitor must be convoyed across the dam, the same inspiring view of the dam and lake can be had from the hill above the dam on the highway from Phoenix. And at Boulder City the sound film portraying the construction of the dam is still being shown.

FORT PECK DAM, biggest—128,000,000 cubic yards of earthfill—in the world, has been storing Missouri waters after releasing them last summer to maintain a navigable depth of 6 feet on the lower Missouri. The reservoir waters were 12 feet deep at the beginning of the year and rising. Fort Peck's reservoir is the longest—189 miles—in the country and covers the largest surface area—245,000 acres. Storage volume falls short of Lake Mead's at Boulder Dam, however, with 19,000,000 acre-feet compared to 32,359,274.

Never-say-die Spirit

AMERICAN ENTERPRISE, spirit, and a willingness to work can succeed in wresting a living from an irrigated farm as small as 5 acres, reports Supt. D. L. Carmody of the Orland reclamation project, California, citing an actual case to prove his point. In 1936 when the outlook for farming was not very bright, a middle-aged couple insisted on buying a 5-acre tract of unimproved project land even though advised that few persons without an outside income had ever succeeded in maintaining themselves from the proceeds from such a small tract of land. They moved onto the place, built a crude shelter and started in leveling a garden spot by hand. After paying cash for the 5 acres, they had but $35 left and no job of any kind in sight. By working out for their neighbors in the hay fields, harvesting fruit, and taking any kind of odd job, they succeeded in clinging to their property. Today, after 5 years, he reports, they have the place clear of debt and well-improved with several cows, chickens, a good garden and lumber ready on the ground for the construction of a substantial residence, and that during the entire 5 years they never received a cent of aid from Federal, State, or county agencies.

THE LANDS of the Columbia Basin reclamation project, not yet irrigated, are already being used for national defense. A portion of the "Potholes," an area of active sand dunes near Moses Lake, in the north central part of the 1,200,000-acre area, is serving as a bombing range, and airports are being constructed in portions of the project.

FORTY ACRES have been bought 2½ miles west of Tucumcari by the Arch-Hurley Conservancy District which plans to transfer the land to the United States for irrigation experiment. Tucumcari is the chief city of the Tucumcari Reclamation project (N. Mex.) now under construction to irrigate 45,000 acres.

WINTER SIGHTS at Grand Coulee are spectacular: A 500-foot snowslide down the downstream face; mountains of snow collected on the transformer deck of the west powerhouse at the bottom of a portion of the incline; and a blanket of ice covering most of the spillway section. Around the 8½-foot outlet tubes carrying the Columbia River through the dam the formation of ice 5 to 10 feet thick.

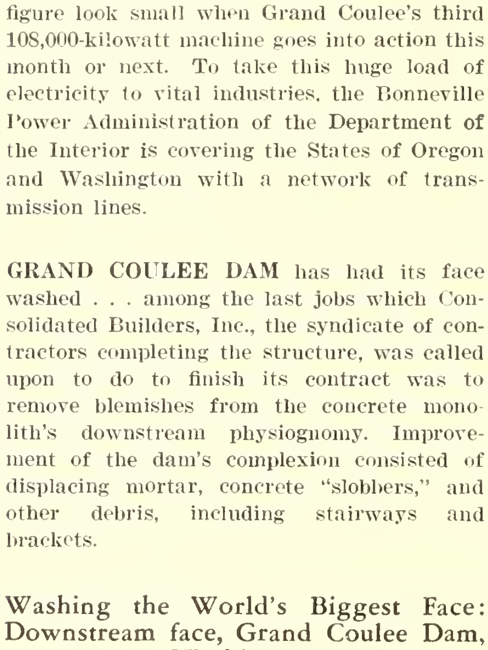
NEW IRRIGATION MANAGER for the Owyhee project in Oregon-Idaho is M. D. Scroggs who has been doing similar work on the Sunnyside division of the Yakima project in Washington. Starting his employment with the Bureau in 1905 as a rodman, Scroggs has worked up through various jobs to his present new responsibility. The Owyhee project is relatively young and will include about 100,000 acres of land.

L–2 Ready for Duty

INSTALLATION of L–2, Grand Coulee Dam's second 108,000-kilowatt hydroelectric generator, was completed January 29. The new hydroelectric machine and its twin are the largest in the world. Their army of kilowatts will serve aluminum plants and other Pacific Northwest industries producing war materials. The first big generator has been producing power since last October. For 6 months before its installation two 10,000-kilowatt station-service generators supplied power for defense purposes. In 1941 the three generators transmitted more than 200,000,000 kilowatt-hours of energy through the Bonneville Power Administration lines to the lower Columbia River area where new factories are situated. The power produced this year is expected to make last year's figure look small when Grand Coulee's third 108,000-kilowatt machine goes into action this month or next. To take this huge load of electricity to vital industries, the Bonneville Power Administration of the Department of the Interior is covering the States of Oregon and Washington with a network of transmission lines.

GRAND COULEE DAM has had its face washed . . . among the last jobs which Consolidated Builders, Inc., the syndicate of contractors completing the structure, was called upon to do to finish its contract was to remove blemishes from the concrete monolith's downstream physiognomy. Improvement of the dam's complexion consisted of displacing mortar, concrete "slobbers," and other debris, including stairways and brackets.

Washing the World's Biggest Face: Downstream face, Grand Coulee Dam, Washington



A WAR BOOM housing shortage has hit Ogden, Utah, reports Construction Engineer E. O. Larson, Provo River project. Labor demands of the Ogden army supply depot, arsenal, shell loading plant (where 750 women have gone to work) and air repair base have brought an influx of workmen who have filled all the tourist camps and left no small apartments or low-rent homes available. The town expects 500 new families a month this year.

DEATH CAME in a Yakima, Wash., hospital January 16, ending a lifetime of building the West for E. F. Blaine, irrigation pioneer in the Northwest, active civic leader and "father" of the Yakima irrigation development.

ONE HUNDRED THOUSAND DOLLARS went to Belle Fourche (S. Dak.) project farmers for the alfalfa seed they produced last year. The average yield from 3,300 acres was 2.3 bushels or $30.40 per acre, in addition to the alfalfa hay, which is the major crop of the project and mainstay of the western livestock industry. This winter saw 164,500 head of sheep on the project being fattened; they average a gain of 30 pounds a head before shipment to eastern slaughterhouses.

APPRAISAL of all irrigable land of the Columbia Basin reclamation project in Washington is complete. Three real-estate experts appraised a 1,689,000-acre area at its dry-land value without reference to prospective irrigation and reported values as follows: Lands which in their present state have value for grazing purposes or marginal dry-farming purposes only, approximately 70 percent of the project area—$1 to $10 per acre. Lands where soil and heavier rainfall permit successful crop production by dry-land methods, about 30 percent of the project area—$5 to $30 per acre. Final tabulations and summaries are not yet available. On the strength of incomplete figures the value of the irrigable area, land only, will be between $13,000,000 and $14,000,000, and with existing improvements between $18,000,000 and $19,000,000. The survey was conducted in accordance with provisions of the Anti-Speculation Act of 1937 which seeks to prevent the development of speculative land prices on the Columbia Basin project which will someday provide a livelihood for 50,000 to 80,000 families.

DEEPEST DIVE in his life was made recently by Walter McCrea, Jr., deep sea diver of Seattle, to recover a steel grating 235 feet below the icy surface waters of the Grand Coulee reservoir along the upstream face of the dam. The grating threatened to interfere with the operation of the penstock pipe coaster gate for one of the big 108,000-kilowatt generators in the power plant. McCrea's father, dead, was also famed for his daring underwater work. McCrea, Jr., had to use a large underwater electro-magnet to find the troublesome grating.

Tulelake's Tenth Birthday

By **B. E. HAYDEN**
Superintendent

FROM THE BEGINNING it was apparent to those who planned the Klamath irrigation project that somewhere within the area of the Tule Lake division a trading center and shipping point would be needed. To provide it, a town site of 160 acres near the center of the agricultural area was selected and platted in 1930.

Thus, deliberately, was the new reclamation town, now 10 years old, brought into being.

The name selected for the new town was Tulelake, and the first sale of lots was held on the ground April 15, 1931, when 209 lots, with an appraised value of $17,100, were offered at auction. On that day 123 lots were sold for a total value of $14,467. The highest price paid for one lot was $700 (this same lot sold 8 years later for $3,400). Since not all lots offered were sold, the sale was adjourned for 3 days and resumed in Klamath Falls, Oreg., on April 18, at which time 9 lots were sold for $945. B. E. Hayden and J. W. Taylor, both Bureau of Reclamation employees, acted as superintendent and auctioneer, respectively.

Tule Lake covered shallowly about 96,000 acres originally near the northern boundary of California. It had no outlet and was fed by Lost River, which has a recorded maximum flow of 9,000 second-feet. The annual inflow ranged from about 84,000 to 427,000 acre-feet.

Between 1910 and 1912 the Bureau of Reclamation in constructing early units of the great Klamath project built Clear Lake storage dam, Lost River diversion dam, and Lost River diversion channel which, together, permitted the storage and diversion, to Klamath River, of nearly all of the run-off that had supplied Tule Lake.

After 1912 Tule Lake receded, uncovering a considerable area of very level—and very fertile—land suitable for farming. These lands were leased to the highest bidder for a few years while canals were prepared, and drains and structures for their irrigation were provided. Some of the crops grown were near maximums; 65 bushels of wheat, 100 bushels of barley and 125 bushels of oats were not exceptional.

The first homestead land was opened for settlement in 1922, and other openings were announced as construction of the irrigation system progressed. The latest opening was on October 25, 1937, which brought the entered area to 25,656 acres. About 7,000 acres yet remain for settlement.

It was in the midst of this very fertile area of approximately 33,000 acres of homestead lands that Tulelake was placed. Already 25,656 acres surrounding the town have been settled by farmers from all parts of the country in tracts of from 40 to 80 acres each. About 100 units are yet to be opened. In addition to the homestead lands, there are also some 20,000 acres of equally fertile lands tributary to Tulelake that, owing to physical conditions, will always be leased to the highest bidder for agricultural purposes.

In a few years more lots were needed in the new town. On April 10, 1936, another sale was held in Tulelake. At this offering 96 lots, with total appraised value of $8,925, were sold for $12,361.50. Remaining unsold lots were picked up from time to time, so that at the end of 1938 all lots in the original plat had been sold.

Few towns supported entirely by agriculture have had the spectacular growth that Tulelake has experienced. Scarcely had the auctioneer's voice died away when plans for construction were in evidence. Within a few weeks a number of business buildings were under construction. The erection of temporary, then permanent, homes were soon under way, and by the end of one year the town of Tulelake was a prosperous and growing village. The population at the present time is estimated at 1,200, although the 1940 census gave only 781.

A considerable growth for Tulelake had been anticipated, however, and the Bureau had reserved a 120-acre tract adjoining the town site on the south for future development. Early in 1939, the town council requested the Bureau to open for sale a strip one block wide along the full width—one-half mile—of the town site. Accordingly, survey was made in 1939 of 6 blocks, containing a total of 84 lots. After considerable preliminary work, this new area was taken into the incorporated town. A sale was held on the ground August 6, 1941, and all lots in the annexed area were sold for a total of $11,490. The maximum price paid was $440 for a lot on Third Street, which had been appraised at $300.

Tulelake suburban residence

The first business establishment to be undertaken was the Siskiyou Implement & Tractor Co., started in 1930, the year prior to the first lot sale, by Earl Ager. Mr. Ager, in 1935, opened up a grocery store on Main Street (Third Street). Business increased so rapidly that he was soon forced to enlarge his establishment to several times its original capacity. In 1940 he put up a modern building, 82 by 100 feet dimensions, which houses one of the most up-to-date general grocery businesses in northern California.

Some idea of the diversity and extent of business activity in this little Reclamation town may be had from the following list of business establishments:

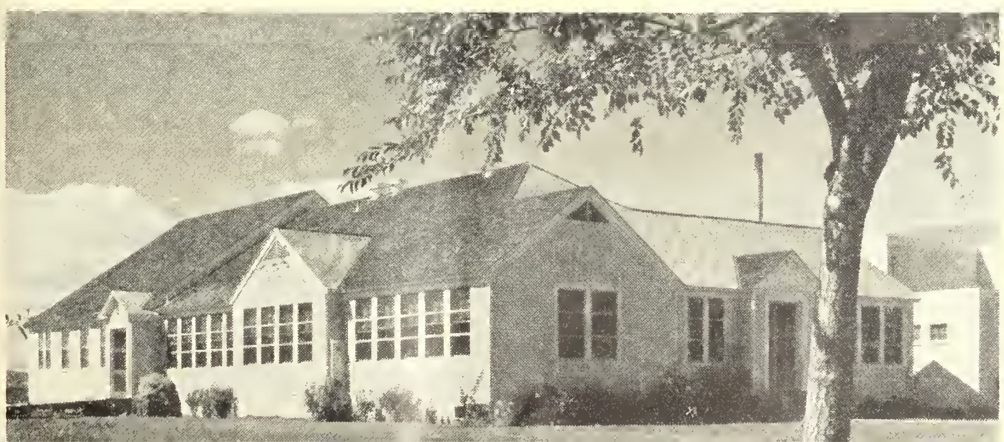
General merchandise stores	3	Hardware stores	3
Grocery stores	4	Feed and warehouse stores	3
Market stores	3	Drug stores	2
Machinery stores	4	Variety stores	2
Cafes	9	Furniture stores	1
Barber shops	2	Fuel and coal stores	4
Beauty shops	2	Welding	2
Garages	3	Hotels	4
Service stations	3	Auto courts	4
Plumbing shops	2	Theaters	1
Lumber yards	2		

Tulelake schools are well equipped and are maintained at the high standard required throughout the State. Enrollment in high school is 176 and in the grades is 200 pupils.

The town council has recently installed a water system at a cost of approximately $50,000 and a sewer system at about an equal cost. The gross tax valuation of the town is $600,000 at 100 percent valuation.

Immediately adjacent to the town is the Tule Lake Bird Reserve, recognized as the finest shooting area in California, where sportsmen come every fall for the open season on water fowl from points as far distant as Los Angeles. During this period all hotels and auto camps are overcrowded.

High school at Tulelake



WAR PROGRAM from Page 50

Fuel for War

Coal provides half the Nation's energy and the rest comes from oil and gas and by water power. Coal is the prime mover of industry, and the basic source of heat and motive power for manufacturing, transportation, public utilities and the home. Coke fires the blast furnaces in the steel mills. The principal supply of many basic chemicals necessary for making munitions, paints, medicines, artificial silk, plastics, etc., is obtained as byproducts of the manufacture of coke from coal.

The Office of the Coordinator for Solid Fuels estimates that more than 600,000,000 tons of anthracite, bituminous, and lignitic coals, will be required in 1942. It is estimated that 70,000,000 tons of coke will be required in 1942. The facilities of the Department have been mobilized to see to it that an adequate supply of coals and coke is available where and when it is needed.

The Department Proposes:

1. To organize the production of coal so that sufficient quantities of necessary types and grades are available for war industries; to see that the supply of other coals is sufficient; to increase the production of coking coal by 10,000,000 tons, if necessary, in order to provide coke for the expanding steel manufacturing program; and to stimulate the expansion of coke manufacturing facilities where and when needed to meet the requirements of war. *Office of Solid Fuels Coordination, Bituminous Coal Division, Bureau of Mines.*

2. To promote orderly production and distribution of coal; to promote the leveling of fluctuations in production and transportation so that plant and carrying facilities can be utilized fully; to encourage stable marketing conditions; to urge the maintenance of large reserves in consumers' storage to encourage the conservation of high grade coals for metallurgical or other specific uses; to maintain close vigil over production, preparation, marketing, transportation, storage, and use of coal for the early detection of situations which might adversely affect the fuel supply, and to recommend the action necessary to correct any such situations as may arise. *Bituminous Coal Division, Bureau of Mines, Office of Solid Fuels Coordination, Geological Survey.*

3. To aid users of special kinds or grades of coal, who may be deprived of their usual supplies in the event of shortages, in obtaining, if possible, substitute coals and in adapting these substitutes to specialized needs. *Bituminous Coal Division, Bureau of Mines.*

4. To promulgate or revise minimum and maximum prices for producers of bituminous coal, as required in the public interest. *Bituminous Coal Division.*

5. To administer the market regulatory features of the coal act in order to keep the bituminous coal mining industry in a sound operating condition and to keep markets stabilized and thereby promote the stable mine production schedules which are necessary to attain full use of mine capacity. *Bituminous Coal Division.*

6. To conduct a rigid mine safety inspection program for elimination of hazards, to conserve manpower, to protect mining machinery and property, and to prevent interruption of mining operations. *Bureau of Mines, Geological Survey.*

7. To establish technical information centers to assist coal and coke producers in maintaining maximum efficiency, and to give scientific aid to consumers in meeting coal utilization problems and to increase war production by improved mining methods and improving the percentage of coal recovered in mining. *Bureau of Mines.*

8. To test certain coals to determine their value for use in the manufacture of munitions, steel, and other products, and their adaptability either for blending with other coals to meet quality requirements or as outright substitutes for other coals for specialized uses. *Bureau of Mines.*

9. To determine the best American coals from which to produce motor fuels and to provide processes for making such motor fuel in case the natural petroleum supply fails to meet future demands. *Bureau of Mines.*

10. To map coal reserves with information on the presence, thickness, depth, quality, and structural conditions affecting the minability of coal in all areas and to administer the coal leasing laws on public and Indian lands under war conditions. *Geological Survey.*

Helium for War

Helium is a light, noninflammable war gas of which the United States Government has a world monopoly. To supply the increased demand for helium that has arisen from the war the Department is drilling four additional wells in the Government-owned fields which supply the Government helium plant; it is increasing the capacity of that plant 50 percent by installing an additional production unit, and it is preparing to construct an additional plant. Effective measures which in the past have prevented any of this helium from reaching the enemy will be continued.

The Department proposes:

1. To double in 1942 the record production of the 1941 fiscal year. *Bureau of Mines.*

2. To make a comprehensive survey of gas fields suitable for helium production, in order to select sites for additional helium plants. *Bureau of Mines, Geological Survey.*

3. To continue research to reduce costs of production of helium. *Bureau of Mines.*

Food for War

Adequate food is essential to success at arms. In many ways the Department contributes to the food supplies of the United Nations. It will increase these contributions. For example, the 1,921 million pounds of fishery products utilized in 1939 can be increased in a few years, without injury to the resources, to 3,582 million pounds through proper management and development.

The Department proposes:

1. To increase as required within the next few years by 1½ billion pounds, our fishing products, principally fish foods for packing, including salmon and sardines, for the armed forces and civilian populations of the United Nations. *Fish and Wildlife Service, Office of Indian Affairs.*

2. To store and deliver water for the irrigation of 10,000,000 acres of land in the arid West for the production of food crops, long staple cotton, and other fibers, and rubber-bearing plants. *Bureau of Reclamation, Office of Indian Affairs.*

3. To assure more adequate forage on Federal ranges for the 12,000,000 head of livestock grazing there in order to increase up to 10 percent the meat, fats, wool, mohair, leather, and other products of critical importance now produced on the 263 million acres of range land; to increase the program for seeding the public lands from 200,000 to 1,000,000 acres a year. *Office of Land Utilization, Grazing Service, Office of Indian Affairs, General Land Office, Bureau of Reclamation, Fish and Wildlife Service.*

4. To increase the production of cane and beets to help meet the shortage in sugar for war purposes and domestic uses. *Bureau of Reclamation, Office of Indian Affairs, Division of Territories and Island Possessions.*

5. To explore, particularly in the Caribbean and the Gulf of Mexico, new sources of aquatic products for use as foods, vitamin oils, and animal feeds; to survey present sources and seek new sources of Vitamin A to supply the domestic demand and the 10½ trillion unit requirements of Lend-Lease; to demonstrate methods of feeding oysters in order to increase by 100,000,000 pounds or 14 percent the food yield; and to develop methods of dehydrating fish. *Fish and Wildlife Service.*

6. To augment predatory animal and rodent control work, including plague bearing rodent control efforts in order to safeguard the Nation's food supplies and health. *Fish and Wildlife Service, General Land Office.*

7. To conduct a food-drying program to relieve demands on tin and containers. *Office of Indian Affairs.*

8. To assure, insofar as war conditions permit, an adequate food supply for the civilian inhabitants of the territories and island possessions. *Territories and Island Possessions, Fish and Wildlife Service, Office of Indian Affairs.*

Land, Water, Timber for War

The increased production of those war necessities which are products of the forest, of the land, and of the water is receiving careful attention from the Department which supervises and manages the Federal land estate of 283 million acres.

The Department Proposes:

1. To increase to a billion board feet in 1942 and to a billion and a quarter in 1943, if required, timber production from the Oregon and California revested lands and from Indian reservations; and to accelerate surveys for scarce species of wood such as Sitka spruce, Rock elm, Port Orford cedar and oak in order to make them available for the armed forces. *General Land Office, Office of Indian Affairs, Office of Land Utilization, Grazing Service.*

2. To establish fire look-out and air-raid warning towers in forested areas and on grazing land; and to provide trained crews to combat forest fires and to man lookout and patrol stations for detecting and reporting fires and aircraft. *Office of Land Utilization, General Land Office, Office of Indian Affairs, National Park Service, Grazing Service.*

3. To assure water supplies for municipalities and military concentrations through such projects as Boulder and Parker Dams in the Southwest, and the Provo River near Salt Lake City and Rapid Valley near Rapid City, S. Dak.; and to propose additional programs for cities such as San Diego where normal water supplies are taxed beyond their capabilities by wartime increases. *Bureau of Reclamation, Geological Survey.*

4. To advance the proposed International Highway to Alaska and other roads in that territory. *Division of Territories and Island Possessions.*

5. To determine, in cooperation with other agencies, how some of the public lands in the southwestern United States and in the territories and possessions may be used for production of rubber-bearing plants. *Office of Land Utilization, General Land Office, Office of Indian Affairs, Division of Territories and Island Possessions.*

6. To map areas of military significance; and to prepare, produce, and supply topographic maps required by the armed forces, and in industrial expansion. *Geological Survey.*

7. To provide certain hospital and other emergency facilities together with medical staffs along the West Coast and in Alaska for use in case of need. *Office of Indian Affairs, National Park Service.*

8. To increase the fur and wool supplies for clothing for the armed forces as well as for other needs. *Fish and Wildlife Service, Grazing Service, Office of Indian Affairs, General Land Office.*

9. To withdraw public lands and to clear them of mineral and other claims so as to permit the establishment of military ranges, cantonments and aviation fields, as well as townsites. *General Land Office, Grazing Service, Fish and Wildlife Service.*

10. To provide special facilities for rehabilitation and recreation of members of the armed forces in need of healthful surroundings. *National Park Service.*

The war program of the Department gives

See WAR PROGRAM, *page* 72

The Columbia Basin New Anti-Speculation Bill

SECRETARY of the Interior Harold L. Ickes on January 30, 1942, submitted to the Congress, with the approval of the Bureau of the Budget, the draft of a new bill to prevent speculation in lands of the Columbia Basin project in Washington and to promote the orderly settlement and development of this, the largest irrigation project undertaken in the United States.

The proposed legislation grows out of joint investigations sponsored by the Bureau of Reclamation and participated in by more than 40 agencies, Federal, State, and local, both public and private, representing all the many interests involved. It is also designed to replace the Anti-speculation Act of May 27, 1937, which is believed to be unworkable and confusing in a number of respects.

Important features of the bill include authority to purchase the privately owned land in the 1,200,000-acre project at values established through impartial government appraisals, recently completed; authority to dispose of this land to actual settlers in tracts platted with reference to soil qualities and characteristics of a size designed to support one farm family; and authority to improve these farm units by such means as the drilling of wells for domestic water, and providing farm buildings and fences; and to make loans to the settlers, provided the credit extended from all Federal sources does not exceed an average of $4,000 per farm unit.

Under the terms of the bill a program for the land acquisition, development, and settlement will be prepared by the Bureau of Reclamation, acting in collaboration with agencies of the Department of Agriculture and others interested, including representatives of the three irrigation districts which have been organized within the area of the project. This program must be completed and approved by the President prior to the time when these phases of the project development are undertaken, and the work must be done in accordance with the program. The program, of course, can be altered or amended in accordance with experience as the settlement progresses. The project settlement and development is not expected to be completed until about 20 years after it is actually begun.

No work has as yet been done on the irrigation system, although Grand Coulee Dam, the principal structure, is about completed on the Columbia River, 90 miles west of Spokane, and the great power plant is partly in operation. Two or three years will be required after work on the canal system is begun before water will be available to any land for irrigation. It is expected that this project will be a major element in post-war readjustment, and it is probable that construction of the irrigation features will be geared to this objective.

The bill would provide for cooperation with the Department of the Interior in the work of settlement and development of the project by the Department of Agriculture and other Federal agencies which have programs that are applicable, and would anticipate joint action.

The antispeculation provisions, largely penal in nature, would remain in effect until 10 years after the particular land involved had been irrigated. As a condition precedent to getting water, a landowner would have to execute a recordable contract agreeing to sell at the appraised price all of his land in excess of the single family-sized unit which he could keep. If later he should sell the land for an excessive price, water could be withheld on action by the Secretary taken within a specified time. The victimized purchaser also would have certain remedies provided in the bill. Fraudulent misrepresentation of the amounts involved in the transfer would become misdemeanors as would fraudulent misrepresentations made in inducing the purchase of any land in the project area.

The bill would provide that, before commencement of the construction of the irrigation features, exclusive of Grand Coulee Dam and appurtenant works now under construction, and the pumping plant at the dam and the equalizing reservoir in the Grand Coulee itself, the irrigation districts must enter into repayment contracts. The State would be expected to ratify the act, as it did the antispeculation act of 1937.

Since it would provide for the purchase of the agricultural land by the Government, the bill also provides for the payment from lease revenues to the local governments money in lieu of taxes on the lands held.

The bill would reauthorize the project, making it subject to the Reclamation Project Act of 1939, and would be known as the Columbia Basin Project Act.

Secretary Ickes said in transmitting the bill that it had been the subject of conferences with the people of the area, and that he believed they would embrace its provisions.

SPEEDY SETTLEMENT of the Roza section of the Yakima project in Washington is reported. Nearly two-thirds of the land was farmed for which water was made available for the first time last year. This year most of the area which will receive water is expected to be farmed. Owing to nearness to town many of the tracts were farmed before buildings were built, and placed in immediate production. The development is more rapid than usual but stable and well planned.

WAR PROGRAM from Page 71

to every scientist, specialist, technician, planner, and worker on its staff an opportunity to contribute actively to the Nation's need now. The Department will enforce adjustment of procedures to complete the common task.

The long experience of the Department in conserving these very resources for the time of need will now ease the task of turning them to the supreme effort. At the same time it will protect the resources themselves from foolish, short-sighted, or wasteful exploitation.

The Department's program is not fixed or static. It will change, and emphasis will shift with the changing fortunes of war.

Thought in all fields will encompass post-war effects, but actions, from Pearl Harbor to Peace, must be justified by their immediate contribution to the winning of the war.

HONOR ROLL

Denver—Secondary Investigations:

Adams, Burr E., junior engineer, Buffalo, Wyo. Second lieutenant, Company B, 26th Engineering Training Battalion, Fort Leonard Wood, Mo. Called to active duty March 21, 1941.

Benson, Homer G., assistant engineering aide, Billings, Mont. U. S. Naval Reserve, Aviation Base, Seattle, Wash. Inducted March 23, 1941.

Berger, Marolf B., junior engineer. First lieutenant, 77th Field Artillery, Fort D. A Russell, Tex. Called to active duty August 18, 1941.

Cateldo, Henry, junior engineer, Billings, Mont. Fort Dix, N. J. Drafted June 17, 1941.

Gabardi, Albert I., junior engineer, Salt Lake City, Utah. 218 Field Artillery, 41st Division, Fort Lewis, Wash. Drafted April 22, 1941.

Homer, J. Wendell, junior engineer, Worland, Wyo. Second lieutenant, Coast Artillery Miscellaneous Station, Camp Davis, Hollyridge, N. C. Called to active duty April 17, 1941.

Jackson, Neil C., junior engineering aide, Boise, Idaho. Second lieutenant, Idaho National Guard, Adjutant General's Office, Boise, Idaho Called to active duty April 1, 1941.

McEwan, John S., junior engineer, Salem, Oreg. Lieutenant, CA-Res., 4th Battalion, 19th Coast Artillery, Fort Rosecrans, Calif. Called to active duty May 30, 1941.

Wilbert, Harry E., Associate engineer, Salt Lake City, Utah. First lieutenant, FA-Res., Corps of Engineers, South Pacific Division, San Francisco, Calif. Called to active duty April 9, 1941.

Altus Project:

Johnson, Algon B., engineer. Reserve officer. Major, Field Artillery, Quartermaster Corps (Constructing Quartermaster), Gadsden Shell Plant, Gadsden, Ala. Entered military service September 26, 1940.

NOTES FOR CONTRACTORS

Specifications No.	Project	Bids opened	Work or material	Low bidder — Name	Low bidder — Address	Bid	Terms	Contract awarded
D-38 212-A	Columbia Basin, Wash.	1941 Dec. 23	Steel reinforcement bars (7,700,000 pounds).	Carnegie-Illinois Steel Corporation.	Denver, Colo.	[1] $32,500.00	Discount ½ percent on b. p. v.; f. o. b. Odair, Wash.	1942 Jan. 15
				Inland Steel Co.	Chicago, Ill.	[2] 32,500.00	do	Do.
				Republic Steel Corporation	Cleveland, Ohio	[3] 33,400.00	do	Do.
				Carnegie-Illinois Steel Corporation.	Denver, Colo.	[4] 32,500.00	do	Do.
				Great Lakes Steel Corporation.	Detroit, Mich.	[5] 27,950.00	Discount ½ percent; f. o. b. Detroit, Mich.	Do.
				Bethlehem Steel Co.	San Francisco, Calif.	[6] 38,610.00	Discount, ½ percent on b. p. v.; f. o. b. Odair, Wash.	Do.
				Colorado Fuel and Iron Corporation.	Denver, Colo.	[7] 15,850.00	do	Do.
1002	Colorado-Big Thompson, Colo.	Nov. 4	69-volt power transformers	Westinghouse Electric & Manufacturing Co.	do	[10] 6,597.36	F. o. b. Kremmling, Colo.	Jan. 8
D-38216-A	Columbia Basin, Wash.	Dec. 23	Cast-iron pier gratings (36), 16-inch draft-tube drain valves.	E. T. Pybus Co.	Wenatchee, Wash.	[1] 1,688.91	F. o. b. Odair, Wash.	Jan. 2
				Stearns - Roger Manufacturing Co.	Denver, Colo.	[2] 12,754.00		Jan. 10
B-33005-A	Central Valley, Calif.	Dec. 30	Annealed copper in rolls (115,000 pounds).	Goldberg Bros.	do	20,332.00	F. o. b. Coram, Calif.	Jan. 14
49308-A	do	Dec. 23	15,000 barrels of modified Portland cement in paper sacks.	Pacific Portland Cement Co.	San Francisco, Calif.	33,675.00	F. o. b. Concord, Calif.	Jan. 15
1012	Columbia Basin, Wash.	Dec. 29	6 hoists for penstock coaster gates at Grand Coulee Dam.	Willamette Iron and Steel Corporation.	Portland, Oreg.	[8] 168,841.00		Jan. 14
						[9] 166,341.00		Do.
1589-D	Rapid Valley, S. Dak	Dec. 12	Furnishing and delivering 4,500 tons of sand.	Reitz and Crites Sand Co.	Rapid City, S. Dak	[1] 3,118.50	F. o. b. Oral, S. Dak.; discount 1 percent.	Jan. 10
1599-D	Central Valley, Calif.	Dec. 29	2 fish-elevating hoppers for Balls Ferry and Coleman station fish traps.	John W. Beam	Denver, Colo	1,800.00		Jan. 7
1603-D	Columbia Basin, Wash.	1942 Jan. 2	Fabricated structural steel for bus structure for left 115-kilovolt switchyard, Grand Coulee power plant.	The Charles E. Schuler Engineering Co.	Newark, Ohio	24,495.00		Jan. 13
1598-D	Central Valley, Calif.	1941 Dec. 30	Furnishing and installing refrigeration equipment for cold storage plant at Coleman station for migratory fish control.	Baker Ice Machine Co., Inc.	Los Angeles, Calif	13,000.00	F. o. b. Anderson, Calif	Jan. 19
1600-D	Boulder Canyon, Ariz.-Nev.	do	8 vertical, welded plate-steel, storage tanks for Boulder switchyard.	Delta Tank Manufacturing Co.	Baton Rouge, La.	1,248.50	Discount ½ percent	Jan. 13
1016	Central Valley, Calif.	Dec. 17	14 102-inch conduit tube valves for river outlets at Shasta Dam.	Hardie Tynes Manufacturing Co.	Birmingham, Ala.	[8] 775,000.00		Jan. 20
				Willamette Iron & Steel Corporation.	Portland, Oreg.	[9] 624,510.00		[11] Do.
1601-D	Colorado-Big Thompson, Colo.	1942 Jan. 12	Main and station-service control equipment for Green Mountain power plant.	NePage Electric Co.	Seattle, Wash.	[1] 21,000.00	F. o. b. Kremmling, Colo.	Jan. 23
				The Wolfe & Mann Manufacturing Co.	Baltimore, Md.	[2] 5,196.00		Jan. 29
D-38212-A-7	Columbia Basin, Wash.	Jan. 9	Steel reinforcement bars (600,000 pounds).	Youngstown Sheet & Tube Co.	Youngstown, Ohio	[12] 13,500.00	F. o. b. Indiana Harbor, Ind.; discount ½ percent on b. p. v.	Jan. 21
1018	do	Jan. 15	Furnishing and installing three 108,000-kilovolt-ampere, vertical-shaft, alternating-current generators.	Westinghouse Electric & Manufacturing Co.	Denver, Colo	2,792,330.00	F. o. b. East Pittsburgh, Pa.	Jan. 3
1021	Central Valley, Calif.	Jan. 6	Rearing ponds and drainage and waters systems for Coleman station, migratory fish control.	David A. Richardson	Winthrop, Wash.	194,168.35		Jan. 23
1594-D	Kendrick and Shoshone, Wyo.	1941 Dec. 16	Carrier-current telephone apparatus for Casper and Thermopolis substations and Shoshone power plant.	General Electric Co.	Denver, Colo	[2] 2,360.00	F. o. b. Casper, Thermopolis and Cody, Wyo.	Jan. 20
						[3] 1,875.00	F. o. b. Casper and Thermopolis, Wyo.	Do.

[1] Schedule 1. [2] Schedule 2. [3] Schedule 3. [4] Schedule 4. [5] Schedule 5. [6] Schedule 6. Shipping from Seattle, Wash., $38,610. Shipping from Lackawanna, N. Y., $44,460. [7] Schedule 8 [8] Item 1. [9] Item 2. [10] Schedule 3 previously reported as awarded to General Electric Co. [11] All bids rejected. [12] Schedules 1, 2 and 3.

443513 U. S. GOVERNMENT PRINTING OFFICE: 1942

e performance. *Left to right:* Kenneth Banghart, narrator; Mollie Morris; Gene Archer, soloist; sound effect engineer at work

"Man is a Giant"

ILLIONS OF PEOPLE are expected to ır their loudspeakers announce this ımatic opening of a new inspirational lio program produced by the Bureau of clamation, and Department of the Inior Radio Section.

The recorded program is a half hour long l tells the story of the building of ulder Dam.

A script written with great imagination ınded out with splendid orchestration, od music, "Man is a Giant" dramatizes e achievement of Boulder Dam and erprets it in the light of mankind's uggle for existence.

onference on script. *Left to right:* annon Allen, Director of Radio Secn for Department of the Interior; illiam E. Warne, Director of Informaon for Bureau of Reclamation; and uis J. Hazam, chief script writer, Radio Section

Completed 6 years ago in Arizona-Nevada, Boulder Dam on the Colorado River is today assuming greater stature than ever. It is the war bulwark of the Southwest. The water impounded by the dam for food needs, domestic and industrial supplies, and hydroelectric power to keep the Southwest's industrial wheels turning and lights burning has become all-paramount to the war effort.

The war has made it necessary to withdraw from the public the privilege of inspecting Boulder Dam and its great power plant. But the forbidden thrill of visiting the structure, the most magnificent engineering achievement of this century, can now at least be vicariously gratified.

The show has been recorded on master records from which 500 pressings have been made. The pressings will be made available on request to individual radio stations throughout the United States.

Pressings from the master records are also expected to send the show to a thousand or more schools in the United States which have play-back equipment. Any school may borrow a record. A school can by special request retain the pressing and place it in the school library or other depository for "repeats."

The script for the show was written by Lou Hazam of the Radio Section, who based his work on the *Story of Boulder Dam* recently issued in book form by the Bureau of Reclamation.

Shannon Allen, Radio Director, was the producer. William E. Warne, Chief, Information Division, Bureau of Reclamation, sponsored the production.

The orchestra which played the music used in the show was specially selected. Several members were from the National Symphony Orchestra of Washington, D. C.

Edward Pierce, arranger, wrote the entire musical score for the production. Gene Archer sang the solos.

Edward Pierce composing music for broadcast on "Man is a Giant" from Interior radio studio

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Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief Clerk	District counsel	
		Name	Title		Name	Address
All-American Canal	Yuma, Ariz	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Altus	Altus, Okla	Russell S. Lieurance	Construction engineer	Frank E. Gawn	Spencer L. Baird	Amarillo, Tex.
Belle Fourche	Newell, S. Dak	F. C. Youngblutt	Superintendent		W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Anderson Ranch Reservoir	Mountain Home, Idaho	John A. Beemer	Construction engineer		B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant	Boulder City, Nev	Ernest A. Moritz	Director of power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont	Paul A. Jones	Construction engineer	Edwin M. Bean	W. J. Burke	Billings, Mont.
Buford-Trenton	Williston, N. Dak	Parley R. Neeley	Resident engineer	Robert L. Newman	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex	L. E. Foster	Superintendent	E. W. Shepard	Spencer L. Baird	Amarillo, Tex.
Central Valley	Sacramento, Calif	R. S. Calland	District engineer	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Kennett division	Redding, Calif	Ralph Lowry	Construction engineer	F. W. Gilbert	R. J. Coffey	Los Angeles, Calif.
Friant division	Friant, Calif	R. B. Williams	Construction engineer	Geo. H. Witte	R. J. Coffey	Los Angeles, Calif.
Delta division	Antioch, Calif	Oscar G. Boden	Construction engineer	F. D. Helm	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Estes Park, Colo	Cleves H. Howell	Project engineer	C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex	Charles P. Seger	Acting construction engineer	William F. Sha	Spencer L. Baird	Amarillo, Tex.
Columbia Basin	Coulee Dam, Wash	F. A. Banks	Supervising engineer	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Davis Dam	Kingman, Ariz	Murray J. Miller	Engineer		R. J. Coffey	Los Angeles, Calif.
Deschutes	Bend, Oreg	Clyde H. Spencer	Construction engineer	Noble O. Anderson	B. E. Stoutemyer	Portland, Oreg.
Eden	Rock Springs, Wyo	Thomas R. Smith	Construction engineer	Emanuel V. Hillius	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Reno, Nev	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo	Irvin J. Matthews	Construction engineer	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Mancos	Mancos, Colo	Albert W. Bainbridge	Resident engineer	Harry L. Duty	J. R. Alexander	Salt Lake City, Utah.
Mann Creek	Weiser, Idaho	Louis B. Ackerman	Resident engineer	Ralph H. Geibel	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont	Harold W. Genger	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Stanley R. Marean	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Mirage Flats	Hemingford, Nebr	Denton J. Paul	Construction engineer		W. J. Burke	Billings, Mont.
Moon Lake	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Newton	Logan, Utah	I. Donald Jerman	Resident engineer	Hugh E. McKee	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo	C. F. Gleason	Superintendent of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Ogden River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Orland	Orland, Calif	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam Power	Parker Dam, Calif	Samuel A. McWilliams	Construction engineer	George B. Snow	R. J. Coffey	Los Angeles, Calif.
Pine River	Vallecito, Colo	Charles A. Burns	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rapid Valley	Rapid City, S. Dak	Horace V. Hubbell	Construction engineer	Joseph P. Siebeneicher	W. J. Burke	Billings, Mont.
Rio Grande	El Paso, Tex	L. R. Fiock	Superintendent	H. H. Berryhill	Spencer L. Baird	Amarillo, Tex.
Riverton	Riverton, Wyo	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
San Luis Valley	Monte Vista, Colo	H. F. Bahmeier	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo	L. J. Windle	Superintendent		W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo	Walter F. Kemp	Construction engineer	John H. McCluer	W. J. Burke	Billings, Mont.
Sun River	Fairfield, Mont	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River Storage	Reno, Nev	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Tucumcari	Tucumcari, N. Mex	Harold W. Mutch	Resident engineer	Charles L. Harris	Spencer L. Baird	Amarillo, Tex.
Umatilla (McKay Dam)	Pendleton, Oreg	C. L. Tice	Reservoir superintendent		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo	Herman R. Elliott	Acting construction engineer	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Vale	Vale, Oreg	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash	David E. Ball	Superintendent	Alex. S. Harker	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash	Charles E. Crownover	Construction engineer	Geo. A. Knapp	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz	C. B. Elliott	Superintendent	Jacob T. Davenport	R. J. Coffey	Los Angeles, Calif.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	A. Oliver	President	Marion Hewlett	Keating.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont			Elsie W. Oliva	Hamilton.
Boise	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise	Black Canyon irrigation district	Notus, Idaho	Chas. W. Holmes	Superintendent	L. M. Watson	Notus.
Burnt River	Burnt River irrigation district	Huntington, Oreg	Edward Sullivan	President	Harold H. Hursh	Huntington.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont		Superintendent	Ralph P. Schefler	Huson.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	S. F. Newman	Superintendent	A. W. Lanning	Austin.
Grand Valley Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo		Superintendent	C. J. McCormick	Grand Jctn.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Roy F. Meffley	Superintendent	C. H. Jones	Lovelock.
Huntley	Huntley Project irrigation district	Ballantine, Mont	S. A. Balcher	Manager	H. S. Elliott	Ballantine.
Hyrum	South Cache W. U. A	Logan, Utah	H. Smith Richards	Superintendent	Harry C. Parker	Logan.
Klamath, Langell Valley	Langell Valley irrigation district	Bonanza, Oreg	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly	Horsefly irrigation district	Bonanza, Oreg	Benson Dixon	President	Dorothy Eyers	Bonanza.
Lower Yellowstone	Board of Control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	R. H. Clarkson	Chinook.
	Fort Belknap irrigation district	Chinook, Mont	H. B. Bonebright	President	L. V. Bogy	Chinook.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery	Chinook.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	President	R. L. Barton	Harlem.
	Paradise Valley irrigation district	Zurich, Mont	C. J. Wurth	President	J. F. Sharples	Zurich.
Minidoka: Gravity	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Assistant Manager	Frank A. Ballard	Rupert.
Pumping	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Moon Lake	Moon Lake W. U. A	Roosevelt, Utah	H. J. Allred	President	Louie Galloway	Roosevelt.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	W. H. Wallace	Manager	H. W. Emery	Fallon.
North Platte: Interstate division	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division	Gering-Fort Laramie irrigation district	Gering, Nebr	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division	Goshen irrigation district	Torrington, Wyo	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division	Northport irrigation district	Northport, Nebr	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden.
Okanogan	Okanogan irrigation district	Okanogan, Wash	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt River	Salt River Valley W. U. A	Phoenix, Ariz	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Sanpete: Ephraim division	Ephraim Irrigation Co	Ephraim, Utah	Andrew Hansen	President	John K. Olsen	Ephraim.
Spring City division	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larson	President	James W. Blain	Spring City.
Shoshone: Garland division	Shoshone irrigation district	Powell, Wyo	Paul Nelson	Irrigation superintendent	Harry Barrows	Powell.
Frannie division	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	Manager		Deaver.
Stan[illegible]	Stanfield irrigation district	Stanfield, Oreg	Leo F. Clark	Superintendent	F. A. Baker	Stanfield.
Strawberry V[illegible]	Strawberry Water Users' Assn	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson			
Greenfield[illegible]	Greenfields irrigation district	Fairfield, Mont	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East [illegible]	Hermiston irrigation district	Hermiston, Oreg	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Uncompahgre	Uncompahgre Valley W. U. A	Montrose, Colo	Jesse R. Thompson	Manager	H. D. Galloway	Montrose.
Upper Snake River Stor[illegible]	Fremont [illegible]ison irrigation district	St. Anthony, Idaho	H. G. Fuller	President	John T. White	St. Anthony.
Weber River	Weber R[illegible] W. U. A	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Ogden.
We[illegible]	Westland irrigation district	Hermiston, Oreg	F. M. Caverhill	Manager	F. M. Caverhill	Hermiston.
Yakima, Kittitas division	Kittitas reclamation district	Ellensburg, Wash	G. G. Hughes	Manager	G. L. Sterling	Ellensburg.

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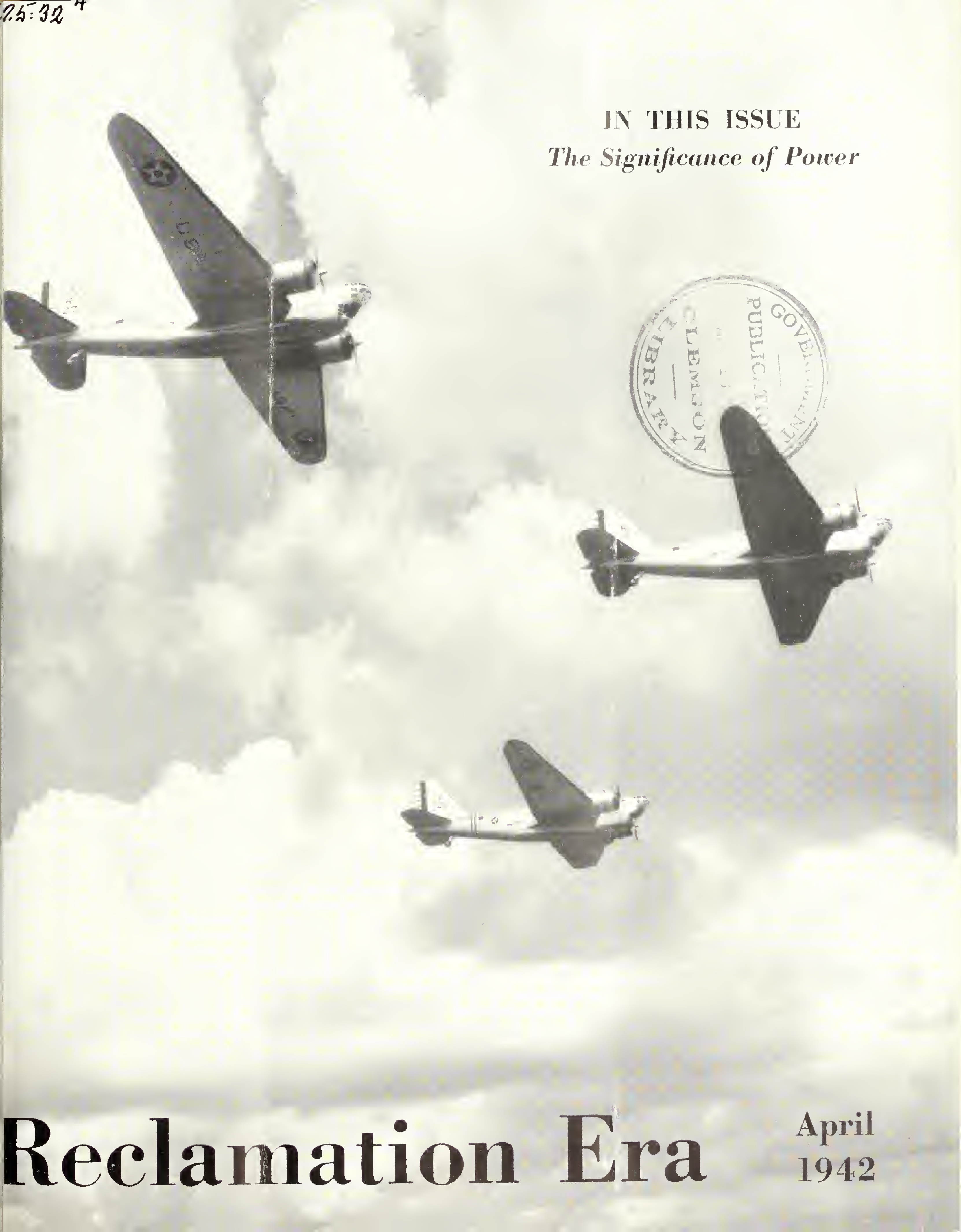

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Publication of Era Suspended

This is the last issue of the* Reclamation Era *for the duration of the war.

Unexpired subscriptions will be placed on record. When publication of the* Era *is resumed, subscribers will receive those issues still due them.

The present editorial board of the* Era *has tried to improve the content and appearance of the magazine since it assumed charge last September. It hopes that readers have approved and that the improvement will continue when publication is resumed.

THIS MONTH'S COVER

Formation of Douglas B-18 A's

The Significance of Power

By **GOODRICH W. LINEWEAVER**
Chief, Research Section

ECTRIC POWER, from a byproduct of gation on Federal Reclamation projects, become a full partner in the national gram for the conservation of the limited er resources of the western United States, for reclaiming the land in that arid and i-arid region.

ower is of vital importance to the in- trial, commercial and agricultural devel- ient of the West. Before the Japanese ick on Pearl Harbor in December 1941, er had won its place. It now becomes even more potent factor in the contribu- of Reclamation to the Nation's war rt and economic welfare.

ower means bombers and fighters in the s.

he power output of Reclamation projects nergizing the machinery of the great war luction industries of the West Coast. It sed for processing foodstuffs, and for the nination of Army posts and naval shore ions. And it is meeting the current needs he civilian population in wide areas.

ach dollar expended for the national war rt requires 2¾ kilowatts of electric er. This emphasizes the usefulness of 7 billion kilowatt-hours which Reclama- projects will provide in 1942, and the ortance of the 20 billion kilowatt-hours will make available annually by 1945. s latter quantity is sufficient for the con- ction of 75,000 fighter planes.

ower as a major feature of multiple- pose irrigation projects has made feasible construction of many projects which erwise would not have been authorized. hout the anticipated revenue from power. projects as Boulder Dam in the Pacific thwest; Grand Coulee Dam in Wash- on; the Central Valley in California and Colorado-Big Thompson in Colorado ld have remained in the planning stages.

n analysis of the construction program of Bureau of Reclamation which covers jects completed, under construction, or horized, illustrates the financial depend- e of reclamation developments on power. ut 50 percent of the repayable costs of these projects will come from power rev- es; approximately 45 percent will be rged to new land irrigated and areas pro- ed with supplemental water supplies; and remaining 5 percent represents costs re- able by municipalities for supplemental er supplies or the portion which will be rged to navigation, flood control, or work ef.

ower produced on Reclamation projects isposed of at wholesale. Under Reclama- law, preference in the sale of power is en to municipalities and other public cor- ations or agencies, and to cooperatives other nonprofit organizations.

Irrigation is given preference in the use of water conserved by multiple-purpose projects, and extensive blocks of power are used for irrigation pumping and drainage.

The development of hydroelectric power has been the basis for the progress of the West since electrical energy became an important factor in the social and economic welfare of the Nation. An average of 75 percent of the energy consumed in the Intermountain and Pacific States is produced in hydroelectric plants.

Low-cost power is responsible for the increased consumption of electric energy in the West as compared with other sections of the country. In the Pacific Northwest the average per-customer use of energy for all purposes is twice that of the country at large.

Reclamation Largest Federal Power Agency

The Bureau of Reclamation is the largest operator of Federal power systems. On February 1, 1942, there were 28 hydroelectric plants in operation on 17 projects in 11 Western States. These plants had an aggregate installed capacity of 1,252,462 kilowatts—more than the total installation in the 11 far Western States in 1912. Plants were in operation in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Utah, Washington, and Wyoming.

A new plant at Parker Dam on the Colorado River which will begin operation in the fall of 1942, with the additions to other existing plants, will increase the total capacity by December 31 to 1,620,462 kilowatts. In 1943, 234,600 kilowatts will be added and in 1944 new units will bring the total to 2,686,562 kilowatts. By December 31, 1945, the hydroelectric installations on Reclamation projects will reach 3,212,662 kilowatts.

The additional capacities will include generating units at Shasta and Keswick Dams on the Central Valley project in California; Anderson Ranch Dam on the Boise project in Idaho; Davis Dam on the Colorado River in Arizona-Nevada; and the Colorado-Big Thompson project in Colorado.

The ultimate installed capacity of the hydroelectric plants in operation, under construction, or authorized on March 1, 1942, was 4,633,162 kilowatts.

Striking examples illustrate the foresight in the planning of power features of multiple-purpose projects. Boulder Dam in the fiscal year ending June 30, 1941, generated 86 percent of the electrical energy produced for the power system of the city of Los Angeles, Calif. It also made possible the transfer of a large block of power to northern California to avert a shortage in the San Francisco Bay area. A new magnesium plant near Las Vegas, Nev., will take one-fourth of Boulder's installed capacity of 869,600 kilowatts by August 1942.

Grand Coulee Dam which will eventually provide water for the irrigation of 1,200,000 acres of productive land began operations in March 1941, with the delivery of power in the nick of time to vital war industries in the Pacific Northwest. Through the Grand Coulee-Bonneville transmission system, the dam is serving aluminum, electrochemical, and other manufacturing enterprises important to the war effort. With an installed capacity of 344,000 kilowatts in the spring of 1942, Grand Coulee will have an ultimate capacity of 1,974,000 kilowatts, making it the largest power plant in the world.

The total output of plants on Bureau of Reclamation projects in 1941 was 3,544 million kilowatt-hours, which equals the total output in the 8 Mountain States in 1935. The gross revenue from power operations in 1941 was $7,328,116, of which $6,168,253 was from Boulder Dam, where 10 of 17 large generators were in operation.

In all, the projects provided more than half of the power and light requirements for a population of 3,500,000 in the irrigation States. This brings to 4,500,000 the number of people served directly by power and irrigation features of Reclamation projects.

While relying mainly on water power as a source of energy, privately and publicly owned utilities in the West have installed limited stand-by steam plants to supplement hydroelectric production. The natural result of this combination of hydro and steam plants is the conservation of water when stream flow is low and the assurances of a greater supply of firm power for industrial, agricultural, and other purposes. These plants also enhance the feasibility of multiple-purpose projects involving irrigation and other purposes.

The Bureau of Reclamation has proposed to supplement its hydroelectric operations with steam plants located at strategic points, where they will serve as important features of multiple-purpose projects. Eight steam plants with an aggregate capacity of 450,000 kilowatts have been proposed to be located in California, Colorado, North Dakota, South Dakota, New Mexico, Texas, and Utah. These plants will utilize western coal, oil, and possibly gas resources.

LAND POLICY

The Background of the Federal Reclamation Act

By **B. PALMER KING**
Associate Attorney

THE PROVISIONS of the Federal Reclamation laws which have as their objective the prevention of speculation in project lands and which seek to preserve Federal Reclamation projects as communities of family-sized farms represent the culmination of many generations of experience in public-land policy; and it is appropriate that these experiences be reexamined as a background for any study of the policy.

An appropriate starting place is with the land policy existing in the colonial America immediately prior to the outbreak of the War for Independence.

Land the King's Monopoly

It is somewhat of a paradox, in view of the vast tracts of raw land in colonial America, that there existed in many of the Colonies an oppressive land monopoly. This situation was due at the outset to the policy of the English Crown of disposing of the lands of the American Continent not to settlers in farm-sized tracts but to proprietors, speculators, and Royal favorites in extensive tracts amounting in some instances to entire provinces. These large holdings in some cases were not subdivided at all;[1] while in other cases they were subdivided not into small farms to be tilled by the owner but into expansive estates which were cultivated by slaves or tenants. These landed estates were kept intact from generation to generation by those relics of feudal law, primogeniture by which property descended to the eldest son, and entail, by which the owner could place restraint upon the alienation of land by his descendants.[2] Vacant lands there were in plenty, but this offered no hope to the colonist since these lands were the property of the Crown and were not open to settlement.[3]

The cumulative effect of these various restrictions was to create and perpetuate a system of land monopoly which made it difficult for the poor man to acquire a farm, and which condemned a large share of the rural population to a perpetual status as farm tenants. This system of land monopoly was undoubtedly the element of English control which the small farmer, the laborer who hoped to become a farmer, and the frontiersman found most objectionable; and with the prospect of confiscation of the Tory estates as an incentive, it is not surprising that these rural people provided the impetus which finally carried the struggle for American independence to a successful close.[4]

Effects of Revolutionary War

The immediate effect of the Revolutionary War was to break completely this monopoly in lands. Within a year from the Declaration of Independence, Thomas Jefferson had secured laws in Virginia abolishing primogeniture and entails; and by the close of the war practically all of the other colonies had followed suit. The Tory estates were confiscated by the various Colonial legislatures and were parceled out as small farms; and in addition, title to the vast domain of the Crown within the Colonies vested in the respective Colonial legislatures, and these lands were opened to settlement. These momentous changes in the land system in America have been summarized by a recent historian as follows:

"The basis of American political democracy has been economic democracy, and at this time, as for long after, economic democracy meant the opportunity to own land. In this respect, the revolution witnessed a notable advance in two directions, the one relieving ownership of certain burdens, and the other increasing the land which could be acquired by the poorer people. All the royal prohibitions with regard to cutting timber were abolished, as were all quitrents everywhere, and whatever relics of feudalism had remained here and there. Entail and primogeniture, without which the perpetuation of great landed estates is impossible, were likewise abolished. In most States it was also provided that the lands of an intestate should be divided equally among his sons, if not all his children. Everywhere the Crown lands and great forfeited estates had come into possession of the State governments, and attempts were usually made to sell these as small holdings. Even in that stronghold of a moneyed aristocracy, New York, a new law discouraged the sale of these lands in parcels of over 500 acres, and James De Lancey's were settled by 275 persons. In Pennsylvania the Penn family estimated their confiscated estates as worth 1 million pounds sterling. Yet more important in providing land for settlement and the building up of the economic democracy of the next 50 years was the cancellation of the restriction against westward emigration which had been embodied in the Royal Proclamation of 1763." [5]

The Public Domain

Near the close of the Revolutionary War the ownership of the lands west of the Alleghenies became a source of bitter controversy among the various States. It was argued by those States which could lay no individual claim to western territory that this area had been won by common sacrifice, and, accordingly, that it should become common property. This view eventually prevailed with the various States relinquishing their respective claims; and thus was created the public domain. In 1784 Congress enunciated the principle that the public domain should ultimately be organized as states; and in 178

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[1] In Pennsylvania, for example, the extensive holdings of the Penn family were not disposed of to settlers but were cultivated by tenants who were required to pay quitrents to the proprietors. Also, the property of the proprietors enjoyed certain immunities including freedom from taxation by the colonial legislature, and this increased the resentment of the Colonists. Open hostility existed between the Penn family and the colonists for over a half century, and in 1757 Benjamin Franklin was dispatched to London to seek an adjustment of grievances. Franklin's efforts were only partially successful, and the controversy between the colonists and the proprietors continued up until the Revolutionary War. The last half dozen pages of Franklin's *Autobiography* are devoted to a discussion of his negotiations with the proprietary and with representatives of the Crown.

[2] It has been estimated that in Virginia, for example, one half to three-fourths of the settled lands were subject to entails. Charles and Mary Beard, *Rise of American Civilization.*

[3] Exemplary of this policy of the Crown to prevent settlement upon vacant lands was the proclamation of George III promulgated on October 7, 1763, prohibiting settlement in the regions beyond the Alleghenies, then recently wrested from France. The material portions of this proclamation were as follows: "All the lands and territories lying to the westward of the sources of the rivers which fall into the sea from the west and northwest are reserved under the sovereignty, protection, and dominance of the King."

[4] "If the merchants and riotous mechanics of the towns unwittingly started the war which led to independence, it was the farmers who supplied the drive that carried it through and who shed most of the blood spilled in the contest. If a Virginia gentleman of high position commanded the army, it was yeomen fresh from the plow who filled the ranks and carried the muskets." Charles and Mary Beard, *op. cit.*

[5] James Truslow Adams, *The Epic of America.* The effect of these changes has been appraised by Charles and Mary Beard, *op. cit.*, as follows: ". . . the destruction of landed privilege in America by the forces unchained in the war for Independence was perhaps as great and as significant as the change wrought in the economic status of the clergy and nobility during the holocaust of the French Revolution."

provision was made for surveying and selling the lands. The policy of selling public lands was in line with Hamilton's plan for using the public domain as a source of revenue,[6] and the revenue motive continued to guide the policy of the Government in the disposition of the public lands until the passage of the Homestead Act in 1862.

The 1785 Act provided for the sale of the public lands in lots of 640 acres and at a minimum price of $1 per acre. In 1796 the minimum price was raised to $2 per acre, and sale by auction was authorized. It was not until 1800 that local land offices were established and sales in tracts as small as 320 acres were authorized, and it was not until 1820 that provision was made for selling lands in farm sized units as small as 80 acres.

While it is undoubtedly a fact that the Government's policy of disposing of its lands in large tracts and by sales held at places remote from the location of the land favored the speculator;[7] this was offset to a considerable extent by the fact that the speculators, being unable to farm the lands themselves, were forced to sell them to settlers upon reasonable terms.[8] The creation of large estates was impossible since no man with sufficient initiative to be a desirable tenant was content with that status when he could secure lands of his own upon favorable terms.

The Homestead Movement

Free land has been a political issue since the earliest days of the Republic[9] when Thomas Jefferson had advocated the doctrine of promoting settlement of the West by free disposition of small farms to bona fide settlers.[10] In the 1820's this doctrine was taken up by Thomas Hart Benton and others. In 1828 the House Committee on Public Lands reported in favor of such a policy, and in his message of December 4, 1832, President Jackson expressed the opinion that "the public lands should cease as soon as practicable to be a source of revenue."

During the 1830's labor joined the ranks of those advocating the policy of donating lands to settlers.[11] Horace Greeley espoused the cause and gave voice to the views of the "land reformers" that the public land system should "be so modified that every person needing land may take possession of any quarter section not previously located, and that none other than a person needing land shall be allowed to acquire it at all." In 1846 several homestead bills were introduced in Congress; but it was not until 1852 that a general bill came to a vote and then it was defeated in the Senate. In 1852 the Free Soil Party urged that "the public lands of the United States belong to the people, and should not be sold to individuals nor granted to corporations, but should be held as a sacred trust for the benefit of the people, and should be granted in limited quantities, free of cost, to landless settlers."

Homestead bills were introduced in each Congress after 1852; but opposition rendered passage of any such legislation impossible. This opposition came from easterners who feared that free land in the West would lower land values in the East, from southerners who opposed the legislation mainly because they believed it would result in peopling the territories with antislavery settlers, and from others who disapproved the measure because it would deprive the Federal Government of a valuable source of revenue.

A homestead bill was passed by both houses of Congress in 1860, but was vetoed by President Buchanan.[12] In 1862 a homestead bill was again passed, and this time it was signed by President Lincoln and became law.[13]

This law permitted any single person over 21 years of age or any person who was the head of a family to select 160 acres of land and to acquire title after residing on the land for a period of 5 years and after completing certain requirements as to cultivation. The original Homestead Act permitted the entryman to commute the requirements as to residence and cultivation after 6 months' residence by paying the regular price of $1.25 or $2.50 per acre for the land. In 1891 the Homestead Act was amended to require 14 months' residence before the privilege of commutation could be exercised, and at the same time it was stipulated that no person who already was the proprietor of more than 160 acres of land in any State or Territory should be eligible to make entry under the Homestead laws.[14] In 1912 the period of residence required before patent could issue was decreased from 5 to 3 years.[15]

Early Efforts to Promote Reclamation

By 1890, much of the arable lands had been appropriated under the terms of the Homestead Act and other laws, and the Nation was again faced with the problem of providing free land as an outlet for the overcrowded population of the East. The only large blocks of public lands remaining were located in the arid regions, and this region could be made to support a substantial population only by irrigation. As early as 1877 Congress had attempted by legislation to encourage the irrigation of arid lands by the settlers themselves but the results of the program were unsatisfactory,[16] and by 1888 National Reclamation had become an issue. In that year Congress became alarmed by the fact that lands which would be needed for reservoir sites and for irrigation works were rapidly disappearing under the liberal

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[6] See Hamilton's Report of July 22, 1790, setting forth a plan for the disposition of the public domain, *American State Papers, Public Lands* (Duff-Green Edition).

[7] It is note intended to convey the impression that the early policy of disposing of the public domain was designed to promote the interests of the speculator. The purpose of fixing a relatively high minimum price for public lands in the first instance was not only to increase the revenue accruing to the Treasury, but was to discourage the purchase of lands for speculative purposes as well. The policy of selling lands in relatively large tracts was determined in part by the expense and difficulty of subdividing the lands into smaller tracts, and in part to the belief that sales in relatively large tracts would promote close settlement, thus decreasing the danger of depredations by hostile Indians. There was much argument in favor of sales of public lands in township units in order to promote close settlement and sales in tracts as small as 640 acres seem to have been accepted as as a compromise. See Benjamin H. Hibbard, *A History of the Public Land Policies* (1939).

[8] Theodore Roosevelt has pointed out that raw land was worth little more than the effort required to cultivate it, and that early speculation in western lands was generally unprofitable. *Winning of the West* (1900). See also Hibbard, *op. cit.,* stating that speculation in western lands was characterized by waves of intense interest followed by periods of depressed prices, and that for the most part speculation led to disappointment more often than profit.

[9] ". . . Free land was engrained in the thoughts and desires of westward moving settlers from early colonial days, but until the west became politically powerful the demand passed unheeded." *Dictionary of American History,* "Homstead Movement" (1939), *v.* 3.

[10] While such undoubtedly was Jefferson's philosophy, he too appears to have been guided in his actions by the need of revenue, for in 1785 he wrote: "I am sanguine in my expectations of lessening our debts by this fund." Hibbard, *op. cit.*

[11] On behalf of labor, it was argued that free land in the West would attract people from the overcrowded areas of the East, and thus enable those who remained to demand higher wages.

[12] Homestead legislation had become so closely identified with radical movements during this period that President Buchanan pointed out in his veto message that the bill would promote the "pernicious social theories which have proved so disastrous in other countries."

[13] Act of May 20, 1862, 12 Stat., 392.

[14] Act of March 3, 1891, 26 Stat., 1098. Prior to 1880 not over 4 percent of the homestead entries were commuted, settlement apparently being made in nearly all cases by genuine homeseekers. After 1880, however, the percentage of commutations increased rapidly so that from 1881 to 1904 nearly one-fourth of the entries were commuted, and from 1910 to 1913 commutations accounted for from 35 to 40 percent of the patents issued under the Homestead Act. After 1914 commutatious were discouraged by the fact that only 3-year residence was required. Hibbard, *op. cit.*

[15] Act of June 6, 1912, 37 Stat., 123.

[16] Desert Land Act of March 3, 1877, 19 Stat., 377. Under the terms of this act one person could enter 640 acres of land and could acquire title at any time within 3 years by making proof of reclamation and by payment of a total of $1.25 per acre. The limit of entry was decreased to 320 acres and the requirement that a total of $3 per acre be expended in improvement was added by the act of March 3, 1891, 26 Stat., 1096. While over 8,000,000 acres of land had been disposed of under the Desert Land Act by 1923, only a small portion of the earlier entries had actually been reclaimed. A special committee appointed in 1903 to investigate the operation of the public land laws reported with reference to the Desert Land laws that:

"It is a fact that a very small proportion of the land disposed of under the terms of the law has actually been reclaimed and irrigated, and scrutiny of many hundreds of desert entries now passing to final proof shows that in the majority of cases these lands are not actually utilized, but are being held for speculative purposes." (S. Doc. No. 189, 58th Cong., 3d Sess.)

terms of the various acts designed to promote the settlement of public lands.[17]

It was feared that the accumulation of these lands in private hands might seriously hamper any sort of comprehensive plan for irrigation of the Public Domain; and in order to forestall such a possibility, legislation was enacted withdrawing all arid lands from entry.[18] At the same time, a special congressional committee was appointed to study the possibilities of large scale reclamation in the arid regions and to draft the necessary legislation to carry out such a program. This committee became hopelessly deadlocked as to the proper method of proceeding, with neither the majority nor the minority favoring direct construction of works by the Federal Government.[19] The result of this failure to devise a satisfactory scheme for large scale reclamation was that in 1890 the arid lands were restored to entry, subject only to the reservation (in patents for lands west of the 100th meridian) of rights of way for canals and irrigation works constructed by the United States.[20]

In 1894 the arid lands States, being unable to secure the reclamation of arid lands by the National Government, were successful in securing the passage of the Carey Act providing for reclamation of arid lands under State supervision.[21] By this act Congress agreed to grant to each of the arid land States not to exceed 1 million acres of land, desert in character, with patent to issue to the State or its assigns upon proof of reclamation. In order to make possible the reclamation of such lands by private enterprise provision was made in 1896 for creating liens against the land to reclaimed.[22][23] The accomplishments under this act, however, were not substantial and National Reclamation was still an issue with the advent of the Twentieth Century.

[17] "Under the desert land laws an individual could acquire title to 640 acres, under the timber culture laws to 160 acres, under the preemption laws to 160 acres, and under the homestead laws to 160 acres, making in all 1,120 acres. It was thus that large holdings were aggregated. The individuals acquiring titles to large tracts of land in this manner which they could not possibly irrigate with their own means, were compelled to mortgage them, and through the agency of these mortgages the titles of these lands are aggregated in the water and land companies, and in many cases, as has already been shown, the individuals acquiring titles to lands were but the agents of the companies themselves, through which the titles were acquired to be transferred to the great landholders. The history of the administration of the Land Office for the past 8 years is instructive on this point." (S. Rep. No. 928, 51st Cong., 1st Sess., p. 170.) [*Ed.:* This quotation illustrates a Congressional frame of mind regarding that period's land laws (1888).]

[18] Act of October 2, 1888, 25 Stat., 526.

[19] While the committee accomplished little in the way of constructive legislation, a comprehensive ten volume report on the irrigation possibilities of the arid regions was submitted to Congress and this report served to focus attention upon the need for a plan of national reclamation. (S. Rept. No. 928, 51st Cong., 1st Sess.)

[20] Act of August 30, 1890, 26 Stat., 391.

[21] Act of August 18, 1894, 28 Stat., 422.

[22] Act of June 11, 1896, 29 Stat., 434.

[23] The act of 1896 authorized the issuance of patents to the State in all cases, without regard to occupancy by settlers.

The Sugar Shortage

and What Reclamation Can Do About It

SUGAR—200,000 tons of it—enough to supply an army of 5,000,000 men at a consumption of 1½ pounds per soldier per week—was produced on land irrigated by the Bureau of Reclamation in 1941.

This year water users on Reclamation projects will probably increase their sugar beet production by one-third.

A mountain of Reclamation sugar beets ready for processing

Next year, if additional factories for processing beets are provided and labor is available, the output from Reclamation projects can double 1941's—enough sugar to provide three quarters of a pound of sugar a week for 20 million men, women, and children of the civilian population.

Twenty-nine projects under the Bureau of Reclamation in 12 States are producing sugar beets. Production on these projects, however, has been limited to about 120,000 acres by acreage limitations under the quota system and by the scarcity of sugar factories. The output has been principally confined to 20 projects in 8 States.

Since factories cannot be completed immediately, substantial expansion of the sugar beet acreage must be deferred to 1943. If adequate factories are available by that time, water users on all of the 29 projects could be prepared to increase production. Projects which produce sugar beets are located in California, Colorado, Idaho, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. New factories may be particularly desirable in Montana, Washington, Colorado, Nevada, and Wyoming.

Projects are under construction in California, Colorado, Idaho, Montana, Nebraska, South Dakota, Washington, and Wyoming, which will make available new acreage fo[r] beet production, as needed. In California water to supplement inadequate irrigatio[n] supplies will be provided by the Central Val[-] ley project and in Colorado by the Colorado[-] Big Thompson project, thus making possibl[e] expanded acreages.

Sugar Beets a Major Cash Crop

Sugar beets are a major cash crop on irri[-] gated land in the West. Beet sugar ha[s] served the Nation in war and in peace, whil[e] beet pulp, a byproduct, has materially aide[d] the western livestock industry. Soil im[-] provement has followed the introduction o[f] sugar beets on Reclamation projects and through it, the production of alfalfa, beans, peas, potatoes, and other crops has bee[n] increased.

"Irrigated land in the West must help t[o] meet the sugar emergency confronting th[e] United States as a result of the presen[t] war," Commissioner Page said. Seventy pe[r] cent of the 2,000,000 tons of sugar produce[d] on the United States mainland last year cam[e] from beets grown on the irrigated land of 1[-] arid and semiarid States. The remaind[er] was provided by sugar beet farmers in th[e] rainfall areas of Ohio, Michigan, and Iow[a] and by the cane growers of Louisiana an[d] Florida.

The reliance which must be placed on bee[t] grows out of developments which have c[ut] off or reduced the supply of sugar availab[le] from offshore areas.

In addition, the demand on cane product[s] for ammunition has greatly increased. Alc[o-] hol for smokeless powder can be made fro[m] cane molasses, which now is in such deman[d] as to reduce supplies which otherwise wou[ld] be available for sugar production.

"Our Reclamation projects will serve [to] the limit of their ability to meet the suga[r] crisis," Commissioner John C. Page said. "[If] additional factories are built, the projec[ts] probably can ease the situation materially."

WOMEN HAVE INVADED man's last stronghold at Grand Coulee Dam because of the draft. A staff of women telephone operators has been hired. The dam's pay roll now lists 15 women where for 8 years only male names appeared.

The Columbia Basin Irrigation Canals

ny discussion of the plan of the rigation system to serve the Colum-ia Basin project made at this time ust be labeled preliminary, tenta-ve, and subject to change. Ulti-ately the system will serve 1,200,000 cres of fertile land in south central Vashington, offer opportunity for a ome and livelihood to 350,000 to 00,000 people. It will be a post-war public work of the first order

By H. A. PARKER
Irrigation Engineer

RAND COULEE DAM raises the water sur-ce of the Columbia River about 350 feet. pumping plant adjacent to the left abut-ent will lift the water an additional 280 et from which point it will be carried rough 1½ miles of open, concrete-lined nal to a reservoir in the bed of the upper rand Coulee.

The Grand Coulee reservoir will be formed placing an earth-and-rock-fill dam across ch end of the Coulee creating a lake 27 iles long, 1 to 4 miles wide, containing 0,000 acre-feet of usable storage. An addi-onal 700,000 acre-feet of dead storage will required in order to bring the water sur-ce elevation to the height desired for di-ersion into the canal leading to the project.

The pumping plant will ultimately consist 12 pumps, each with a capacity of 1,600 bic feet per second or a total capacity of ,200 second-feet. Each pump will be driven a direct connected 65,000 horsepower syn-ronous motor and one generator in the owerhouse will handle two pumps. The mo-rs will operate at generator voltage thus iminating the need for transforming the rrent. The pumps will discharge through eel conduits 13 feet in diameter and about 0 feet long. The 12 tunnels in which the pe will be placed are already excavated.

The reservoir in the Grand Coulee serves vo important purposes. It takes the place 27 miles of canal, the cost of which would almost prohibitive because of its location ong the sides of the canyon, but even more nportant is the effect it will have on power quirements. By drawing on the storage it ill not be necessary to pump at the same rate all times that water is being diverted to e canal system. This will permit the aximum utilization of power by decreasing e rate of pumping during periods of maxi-um commercial load and replenishing the eservoir during off-peak periods.

Leaving the reservoir at a point near Coulee ity the canal with a capacity of about 15,000 ıbic feet per second runs in a southerly rection for about 4 miles through open anal, the Bacon siphon and the 2-mile Bacon Tunnel. It is at this point that the first major change of plan is indicated. It is now proposed to utilize a narrow basaltic canyon about 2½ miles in length in lieu of a canal bordering its side. To accomplish this a low dam is required at the south end to maintain the necessary water surface ele-vation. Two miles further on it is proposed to drop the entire flow in the canal about 195 feet, utilizing the fall to develop electric energy which will be used to pump water to lands adjacent to but higher than the main canals. This is a radical departure from the original plan which contemplated running the main canals as high as possible and placing power drops in several of the laterals.

New Plan Requires More Pumping

Obviously the new plan will require more supplemental pumping to reach the same number of acres. Also, the question is im-mediately raised—why relinquish any of the elevation gained by the pumping already done at Grand Coulee Dam? There are several factors in the answer to this question. The foremost consideration is one of securing a more economical location for the canal. In the original plan many miles of the canal ran through precipitous country requiring a great many tunnels and other expensive structures. Under the revised plan as much as 8 or 10 miles of tunnel and siphon are entirely eliminated. This is a considerable saving when it is considered that a mile of tunnel may cost as much as 6 miles of open canal. It has also been found economical to run the canals on a somewhat flatter grade. Savings of elevation from this, plus the grade saved by the elimination of the tunnels and siphons result in the new and the old loca-tions approaching the same elevation as they proceed down the project. This is not ob-jectionable because the difficult construction is nearly all near the upper end.

Another important consideration is the fact that the first blocks to be irrigated can be reached with a great deal less construction expenditure. Detail figures are not avail-able for this saving but it is conservatively estimated to be several million dollars.

Portions of the higher lands along the east-ern border of the project are now being cul-tivated by dry farming methods. Under the proposed plan, irrigation would be provided first by gravity to the low lands where irriga-tion is a prerequisite to successful farming and later by pumping to the higher lands as may be required.

Returning again to the site of the power drop, advantage is taken of another depres-sion, in which Long and Coffee Pot Lakes are located, to serve in place of an excavated canal. This will be about 5 miles long and will require an earth dam 100 feet high at the lower end in order to hold the water surface at the desired elevation. Six and one-half miles further on the canal is divided into the East and West branches, the East continuing in a generally southerly direction to the viciniay of Pasco and serving all the land in the East and South Columbia Basin irrigation districts. The West branch runs southwesterly past Soap Lake and Ephrata to Quincy where it turns south, finally pass-ing under Frenchman Hills in a tunnel and serving all of the land in the Quincy-Columbia Basin irrigation district.

With the exception of comparatively small areas on which pumping will be required, all the land below these canals will be served by gravity. Land adjacent to, but on the high side of the canals will be irrigated by pumping from the canals using seasonal power developed at the power drop.

Present plans contemplate concurrent de-velopment in each of the three irrigation dis-tricts. To accomplish this it is obviously necessary to provide some means of irriga-tion in the south district other than through the main canal system because it will be many years under any reasonable construc-tion program before the canal would reach that district. It is planned, therefore, to construct a pumping plant on the river a few miles northwest of Pasco and irrigate as much land as can be economically reached by direct pumping from the river. When the gravity canal reaches that vicinity, possibly 25 years from now, it will be entirely feasible to supply the pumping system therefrom and discontinued operation of the pumping plant. The Burbank area south of the Snake River, also in the south district, will be irrigated by pumping directly from the Snake River.

In an area as large as the Columbia Basin the amount of water returning as waste, seepage, and percolation amounts to a con-siderable quantity. The recapture of this is a direct saving on pumping costs and required canal capacity. Physical conditions will not permit the use of all return flow but for-tunately there is an opportunity to recover a considerable portion by building a storage reservoir in the Potholes area south of Moses Lake. This will be formed by constructing an earth dam across the Crab Creek chan-nel at the extreme east end of Frenchman Hills. A canal leading from this reservoir will feed into the East canal system near Othello, Wash., and will make it possible to use the stored water in the southern end of the project.

The Sculptures at Boulder Dam—Part III

FROM BONES of Water Pipe and Wood

By **OSKAR J. W. HANSEN**, *Sculptor*

In a previous article Mr. Hansen deftly withdrew the veil and showed by what processes the monument at Boulder Dam was conceived. Here he tells how it was done.

LEGITIMATE CURIOSITY accounts for the ever present desire to come upon the sculptor while he works. When confronted by the results of such work the word "beautiful" seems to be the inclusive word by which the public express approval of an object which they like. I saw "beautiful" form a half million times on the lips of people who came to see my works on Boulder Dam. Each of them did light, in the words of Shakespeare, "the faggots" they had "brought." It is therefore a pleasure to implement their understanding by answering the questions asked me most frequently by the public while out on the Dam. It was, "How do you begin?"

Since the subject of the sculptures on Boulder Dam is man, a true answer to the above question would be that one begins where man began: "In the beginning." It would be a declaration fully as direct as when the poet says, "We are such stuff as dreams are made on." "What then," I hear you ask, "on what stuff are dreams made?"

So I sought a more homely simile when I answered this inquiry once by a return question. "Madame," I said, "when you peel an orange, do you begin by sticking the end of your thumb into its center?"

Mine was not a facetious reply. I implied that in a creative sculptor the vision of the whole in the terms of its parts had to be so keen that he may with safety remove from a block of marble that part of the stone which he does not need. What remains is the immortal residue. Inversely, there is no fixed point of rest, as I said in an earlier article, from which a sculptor's image may be projected into form. Creation is a simple and direct act which has its basis in knowledge. If, like The Lord in Genesis, one knew the true nature of Light, one could say also quite directly, "Let there be Light."

In other words, the sculptor has to know, figuratively, that his orange has a peel, that inside this peel lie a series of segments within the pulp of which are contained both the juice and the seeds. If he has such foreknowledge, he may work on his orange so as to obtain either the juice or the seeds, or both.

It follows that peeling an orange does not constitute the whole knowledge concerning this fruit. One does not thereby come to know how it grew or the other series of facts which would be essential to the knowledge of a botanist. However, a person wishing to enjoy an orange could say much in the manner of Gertrude Stein that, *an orange is an orange.* It is neither vapid nor uninteresting, therefore, to discuss the mechanics of monument making.

The inception and the basic ideas inherent in the Winged Figures of the Republic were given in a previous article.

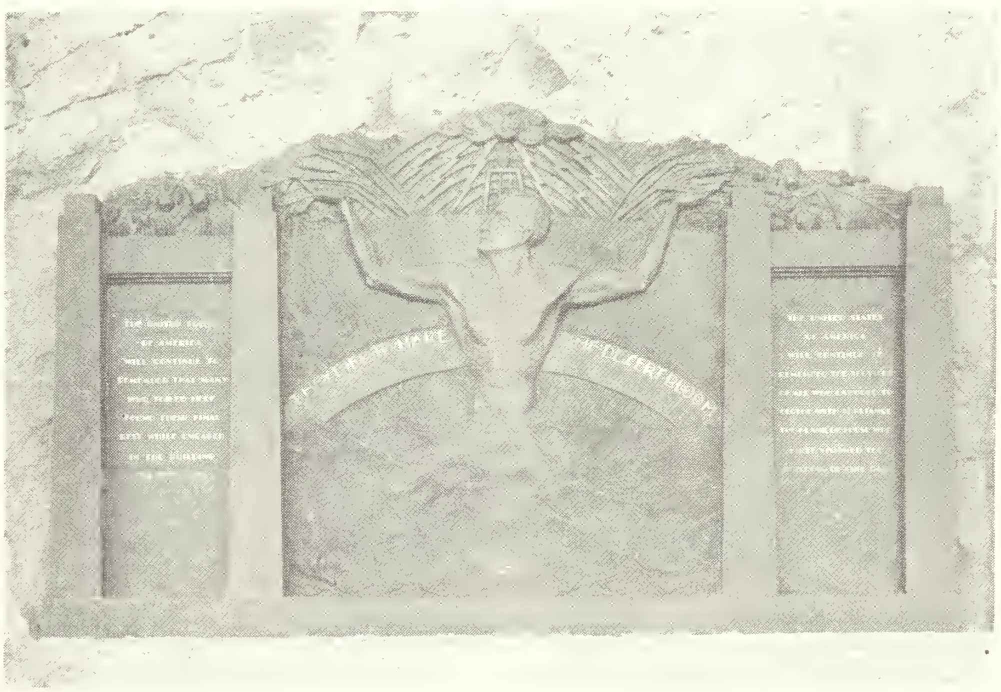
The technical side of their making, from bones made from water pipe and wood, the final model, the sand molds weighing 492 tons with 18-inch I beams to hold the pressure of molten metal, the sand cores, the baking and the final tense moment when more than 4 tons of statuary bronze, heated to 2,500° F., was poured in a molten stream to form their continuous shells just five-eighths of an inch thick and 30 feet high from toes to wing tips, is a saga of its own inviting parallel in the history of sculptural art.

All these operations were precarious, some were unprecedented, and as a result of any of these mechanical cocoons through which these figures passed their "bones" could have "withered," so to speak, and their "hopes" been "lost." That they now spread their shining wings over Boulder Dam is a credit to many willing hands whose patience and skill assisted the sculptor in these processes which were sometimes menial. Of these artisans a demand was made for far more than manual skill. They had to visualize vicariously the final purpose of the sculptor, so that the birthright of these figures would not be lost inadvertently.

There were many collateral reasons for permitting the figures to be composed as they are now. The flagpole, the vertical cliff behind the plaza, the rise of the dam out of the Gorge of the Colorado, the flag, itself, up in the blue; all of these made a vertical composition mandatory. The distant view of the Fortification Mountain and the closer mesas made it desirable to break this vertical composition with the single angular bend of the seated posture. The shape and surface areas of the wings were not only calculated

Left: **Sculptures in concrete on the Arizona elevator tower. The inscription says:**
SINCE PRIMORDIAL TIMES AMERICAN INDIAN TRIBES AND NATIONS LIFTED THEIR HANDS TO THE GREAT SPIRIT FROM THESE RANGES AND PLAINS. NOW WITH THEM IN PEACE BUILDETH AGAIN A NATION.

Right: **Sculptures in concrete on the Nevada elevator tower. The inscriptions:**
FLOOD CONTROL NAVIGATION IRRIGATION WATER STORAGE POWER.



Below: **Memorial to labor set into the cliff of the Arizona abutment. THEY DIED TO MAKE THE DESERT BLOOM. THE UNITED STATES OF AMERICA WILL CONTINUE TO REMEMBER THAT MANY WHO TOILED HERE FOUND THEIR FINAL REST IN THE BUILDING OF THIS DAM. THE UNITED STATES OF AMERICA WILL CONTINUE TO REMEMBER THE SERVICES OF ALL WHO LABORED TO CLOTHE WITH SUBSTANCE THE PLANS OF THOSE WHO FIRST VISIONED THE BUILDING OF THIS DAM.**

to convey a potency for flight but to repeat the shadow wedge areas created by the serried buttresses along the face of the dam, but in the inverse order.

The patterns on the pavement are crystalline in line and spread out horizontally toward the Diorite base from whence the figures reach their wings up toward the flag. The objects on the polished floor are reflected into the planes and curves of this Diorite base. This igneous rock lent itself admirably to this purpose. It is hard, even of texture and received a wonderful polish. The volutes and facets on this stone were carefully designed to reflect the light of the sun in bright diagonal shadow patterns upon the polished terrazzo.

The Diorite deserves a special mention. This stone has for ages been a favorite with sculptors and was used with telling effect by the masters of the Golden Age in Egypt. It remained for our country, from near Santa Ana, Calif., to produce the finest known variety of this stone. I may say in passing that these huge blocks, so highly polished, could not be placed by ordinary methods. They were lifted onto blocks of ice and guided into their closely fitted places as the ice melted from under them. When the base was thus in place the bronze-bearing steel flagpole was dropped through a hole in the central block, down into a prepared socket deep in the mountain. The golden ball mounts 142 feet above the star-map.

The figures were spaced a correct distance apart so that from whatever angle they should be viewed, their wings would point in unison upward along the two sides of a triangle at the apex of which the flag flies. I must again mention the use of polished surfaces and reflections. I could not compete with the majesty of the mountains as to size, nor with the arc of the dam, itself, for majestic sweep of line. I chose to make this monument, in spite of its great size, very much in the nature of a jewel with many sparkling facets to reflect the wider horizons of man's being and of man's world. It was my hope that those

who step from the roadway of everyday life onto the polished pavement among the stars of the star-map about the base of the monument may feel the exhilaration of a journey far flung in intent and native to the dynamic and adventurous spirit of America.

On the Arizona side of the dam, the mountain holds a memorial placed by the United States in enduring bronze for those who toiled and died. On this bronze is carried also an appreciation of those workmen who carried the structure to completion. Here the United States sets the precedent of commemorating the abiding dignity of those who labor.

On one elevator tower, a series of five bas-reliefs in concrete show the purposes served by Reclamation projects; and on the other, the visages of those Indian tribes who have inhabited those mountains and plains from ages distant. From the appeal of freedom which existed in the breast of the Red Man as he reaches his hands toward his *Great Spirit* above to the joint effort for the building of a common destiny depicted in the act of peace on the lower panel, these reliefs express in visible symbolism the abiding values of our Nation.

This report does deal, in the way that sculpture itself must deal, with many intangible values. If this were not so then men would not commemorate their existence in such monuments. The problems which the sculptor must face and with which he must deal in his art are the problems analogous to the infinite paradox of life, itself.

It has come to me with deep conviction through the building of this monument as a setting for our flag that an inherent respect for the individual is the keystone of the American mode of life. Out of these pages shines the belief that to draw the breath of life is in itself a stupendous wonder; an achievement precious to the knowledge and care of the Creator. It is with this conviction that we of the Americas must face the future; with tolerance for the entity of the individual regardless of His gifts.

Greater far than Boulder Dam is the object lesson it teaches in the humanities. Through tolerance, the unquenchable spirit of America will aspire, like the Winged Figures of the Republic on Boulder Dam, ever upward to keep our flag in the blue.

A STUDY of irrigation by sprinkling is being made by several of the participants in the Columbia Basin Joint Investigation planning the successful development of the 1,200,000 acres to be watered by Grand Coulee Dam. Advantages of sprinkler irrigation and probable costs of installation and of operation of different types of systems are being checked. Although great advantages for sprinkling have been found, information bearing on prospective costs are too meager for definite conclusions, the investigators report. It has been suggested that sprinkling systems might prove advantageous in community pastures which are being given consideration.

The WAR ROLE of the

WITH THE NATION at war, what will be the effect on the Reclamation program in general and the Central Valley project in particular? A fundamenta[l] peacetime program of project construction has been geared to a long-rang[e] plan looking toward increased economic security and added national wealth[.] On the other hand an intensive war program requires all-out production fo[r] victory. Obviously anything which is in conflict with the needs of the wa[r] must be shelved. Equally clear is that certain of our conservation activitie[s] must not needlessly be interrupted, for in them will be found the sinews o[f] America's development. The answer to the problem is perhaps found in th[e] Central Valley project, which serves to strengthen the Nation's war effort

MIGHTY Shasta Dam—keystone of the Central Valley Reclamation project—has reached almost 70 percent of completion. Work on this structure, second largest of its kind in the world, is now considerably ahead of schedule. By controlling the flood flows of the Sacramento River, Shasta Dam will make available a surplus water supply for export into the San Joaquin Valley, and thereby make possible the fulfillment of irrigation plans—regulation and reapportionment of the flow of the San Joaquin River by Friant Dam and the canals diverting from it.

At the base of Shasta Dam concrete pouring is almost complete for the powerhouse, and installation of the first of five huge electric generating units is under way. Also at Shasta a new railroad 30 miles long has been built to carry the main line of the Southern Pacific around the reservoir, an auxiliary job which has involved construction of the world's highest double-deck bridge across the deep Pit River Canyon. Finishing touches now are being put on the bridge and railroad which will be opened to train traffic within a few weeks.

Another Central Valley project dam—Keswick Dam—is being built on the Sacramento River 9 miles below Shasta for reregulation of water releases from the Shasta Power Plant and for fish trapping facilities in the salmon rehabilitation program. Keswick also will generate power.

In the delta area of the Central Valley, part of the project has been in service for almost a year and a half. The Contra Costa Canal, scene of the first project construction in October 1937, is in operation for a distance of 29 miles, furnishing fresh water to a steel mill and a chemical company at work on war orders, as well as to other industrial, domestic, and agricultural consumers in the area of growing population which it serves. An additional 15 miles of the Contra Costa Canal are completed or under construction.

In the San Joaquin Valley Friant Dam is 95 percent complete, already providing some measure of flood control on the San Joaquin River. A new reservoir has been created in the foothills east of Madera—Millerton Lake[.] The reservoir at present extends 6½ mile[s] above the dam. The Friant contractors[,] Griffith Co. & Bent Co., have brought the da[m] to near completion a whole year ahead of th[e] schedule in their contract.

Since November 1939, 1,300,000 cubic yard[s] of earth and rock have been excavated t[o] provide a firm foundation for the dam; [a] very efficient construction plant, featured b[y] the long steel trestle and its giant cranes[,] has been built; more than 4,000,000 tons o[f] aggregate have been taken from the old rive[r] bed below Friant and processed into sand an[d] gravel for concrete; and manufactured an[d] placed in the dam are over 2,100,000 cubi[c] yards of concrete—enough to pave a moder[n] 4-lane highway from San Francisco all the wa[y] down the valley and over the ridge to Lo[s] Angeles.

The slow process of topping off the dam t[o] its final height 320 feet above the lowest bed[-]rock foundation is under way, and excep[t] for the installation of drum gates and valves[,] the dam will be completed this spring. I[t] stands today as the fourth largest masonr[y] dam in the world. Incorporating a numbe[r] of technological improvements developed i[n] the past few years, Friant Dam is an out[-]standing engineering structure among th[e] 165 dams designed and built by the Unite[d] States Bureau of Reclamation since it wa[s] organized in 1902.

Work also has been under way on th[e] Madera Canal for more than a year. Th[e] first 8-mile section is excavated. Concret[e] lining operations began in December an[d] more than 2½ miles have been lined to dat[e.] Three canyon siphons, three highway bridges[,] a number of farm bridges and other necessar[y] structures have been built. The diversio[n] capacity of the canal is 1,000 cubic feet pe[r] second, with the structures built to permi[t] enlargement of the capacity to 1,500 cubi[c] feet per second if required in the future. Th[e] 8-mile section, including the connecting lin[k] with the dam, will be completed this spring[.]

Rounding out this review of Central Valle[y] project construction work done so far, engi[-]

Central Valley Project

Highlights from an address by WALKER R. YOUNG, Assistant Chief Engineer, United States Bureau of Reclamation, at the annual meeting of Madera County Chamber of Commerce, February 25, 1942, Madera, Calif.

Food Will Win the War and Write the Peace. As this is written in larger and larger letters owing to the emphasis time will give to it, the irrigation features of the Central Valley project may take on emergency importance as a means of assuring an adequate supply of certain vital foods needed to balance the diet of our armed forces, the growing army of civilian-defense workers, and the peoples of the United Nations.

So, an analysis of the effect of the war on the project has brought out two main points—one positive: that its power output will be pushed ahead at all possible speed; and the other speculative: that its irrigation features, although deferred for the present, may be expedited in the future should the need be demonstrated for greater food production or production of other critical agricultural products.

Translating these factors into a construction program for the immediate future, it is obvious that most of the new work this year is to be on the northern end of the project where the power is being developed. President Roosevelt has included in the 1942–43 war budget a request for an additional appropriation of $48,769,000 for the Central Valley project. The amount, if provided by the Congress, will finance a continuation of construction on Shasta Dam and Keswick Dam, manufacture and installation of power-plant machinery, first construction on power transmission lines, and a start on the steam-electric plant scheduled to be built in the general vicinity of Antioch. No commercial power is to be generated at Friant Dam because of the seasonal nature of its operation and the necessity for diverting most of the water into the canals at a relatively high elevation to permit gravity flow to the irrigable lands of the valley.

Any construction program at this time is limited not only by the availability of funds but also by the availability of materials. Even though funds were on hand for starting new canal work, no headway could be made without a priority for materials. The next section of the Madera Canal, for instance, from the end of the present work to the Fresno River crossing, includes a number of structures such as bridges, siphons, culverts, turn-outs, and wasteways—all requiring reinforcing steel, an item difficult to obtain at this time. The same is true, of course, for the Friant-Kern Canal. Although construction work on these features is deferred, the engineering work of planning and designing will be continued by the Bureau so that when circumstances again permit it should be in

neering studies and field surveys are far advanced for an additional 350 miles of irrigation canals and for over 200 miles of power transmission lines. The cost of the entire project is estimated at $264,000,000. Federal funds have been made available to date in the sum of almost $111,000,000 of which about $92,000,000 has been spent for labor, materials, equipment, rights-of-way, and water rights. The principal project features on which construction has not yet started are the great Friant-Kern Canal, the Antioch Steam-electric Plant, Shasta-Antioch Transmission Lines, the Delta Cross Channel, and the Delta-Mendota Canal.

The Potential Electric Energy

With the world crisis emphasizing the necessity of protecting and mobilizing our natural resources, there is no doubt that some phases of the Central Valley project are important in the war program. This was realized as far back as september 1940 when the Bureau of Reclamation organization on the project was classified as one of the Federal defense agencies.

In a multiple-purpose development as broad and diversified as this one, certain of its aspects are bound to differ from others by the change from peace to war. One phase of the Central Valley project immediately recognized as of prime wartime importance is its potential electric power. Surveys of the Nation's power resources indicate an early shortage of electric energy in certain areas to turn the wheels of war production.

One of these areas embodies northern and central California where construction is started or proposals are pending for a number of new industries, including additional shipyards, automotive and aircraft factories, a magnesium plant, another steel mill, more oil refineries, and possibly synthetic rubber mills. All these require large amounts of electric power.

Fortunately the Central Valley project, with power plants under construction at Shasta and Keswick Dams, is in position to meet this essential need at a relatively early rate. Every effort is being made by the Bureau of Reclamation to speed the construction of these plants which will make available 450,000 kilowatts of electric power.

The Office of Production Management assigned a materials priority rating of A–1–e to Shasta Dam and all related work necessary to bring its power plant into operation, such as the railroad relocation and reservoir clearing. First Shasta power may be on the line early in 1944. Keswick Dam, which carries a priority of A-2, may be brought into power production before the end of 1943. Except for purposes of operation and maintenance, no other feature of the Central Valley project carries a standing materials priority at this time. At the moment, power is king.

The Central Valley project has wartime value to the country in other ways. For instance, the Contra Costa Canal is delivering water to a number of industrial plants engaged in war production. Also, the flood control benefits soon to be realized from both Shasta and Friant Dams certainly take an extra importance at this time. Finally, there is tremendous potential wartime value in the irrigation features.

Agriculture so far has not been officially classified as a basic war industry, and accordingly new irrigation works have not been recognized as entitled to any construction priority. That was brought home forcefully to the San Joaquin Valley last December when the Bureau of Reclamation had to reject bids for building the first section of the Friant-Kern Canal, because it was impossible to obtain the necessary priority on materials. But it is possible that changing conditions (and they change rapidly these days) may alter this course.

If war needs should develop an urgent requirement for new sources of food supplies, the expansion of irrigation will assume real importance. This land may be able to make a contribution in other ways, now undiscernible. Rubber, for example, might make a difference. It can be grown in California.

The Central Valley project involves the preservation of *existing* agricultural development—it aims to maintain production, and, if necessary, to expand it in an area already furnishing large shares of important specialty crops. This makes it peculiarly able to help, if and when the need becomes critical.

For instance, from Central Valley vineyards comes three-fourths of this country's supply of grapes and raisins. Central Valley farms produce 78 percent of the American olive crop, 66 percent of the almonds, almost 50 percent of the apricots, 96 percent of the figs, 75 percent of the plums, and 33 percent of the prunes.

A recent Giannini Foundation report on The Effect of the War on California Fruit Industries says: "All the fruit produced in the United States in recent years would be insufficient to provide the amount of fruit needed for the optimum health of everyone in the Nation." Under the Food for Freedom campaign there already has been a call for increased production of some California crops, such as tomatoes, sugar beets, dried fruits and vegetables, as well as milk products, poultry, eggs, and meats.

The Department of Agriculture thesis is

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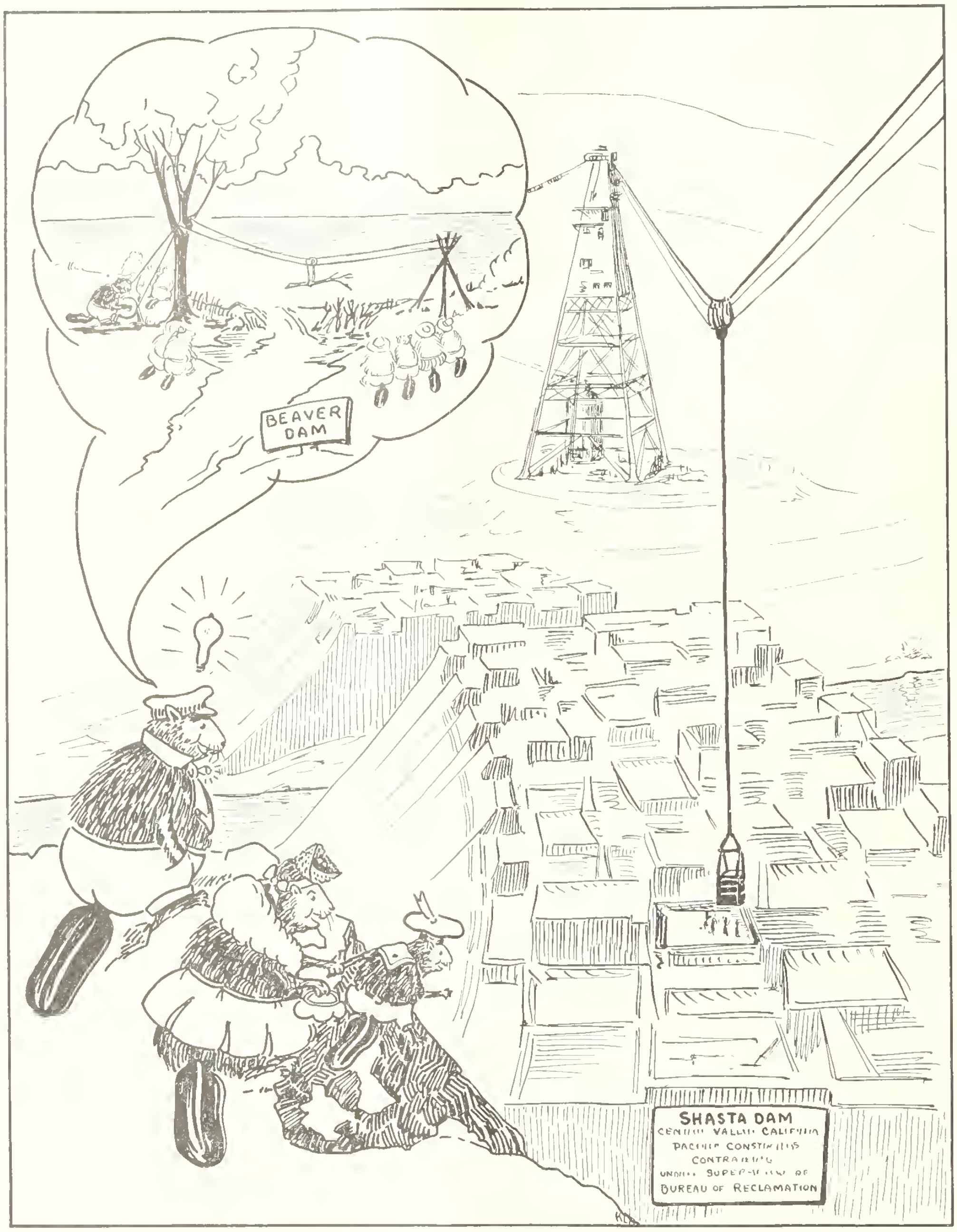


good position to go ahead at full speed with canal construction.

Canal construction must be deferred, but two real benefits should be derived later: First, a probable saving in the cost of the project which will be realized by bypassing this period of high prices; second, a backlog of work will be provided for the time when the emergency is past, with defense plant workers and returning soldiers looking for jobs.

The irrigation features of the Central Valley project all are dependent directly or indirectly upon Shasta Dam. None of them can be utilized to full advantage until Shasta Dam and other parts of the project are completed. For instance, the rights to store water in Friant Reservoir are being secured, in part, through an exchange to be effected by importation into the San Joaquin Valley of water released from Shasta Reservoir.

Before any substantial part of the San Joaquin River flow in years of low run-off can be held back at Friant for diversion to lands under the Friant-Kern and Madera Canals, a substitute supply must be furnished the present water users diverting at Mendota Dam on San Joaquin River. This substitute supply will be brought from the more abundant Sacramento River through the Delta Cross Channel and the Delta-Mendota Canal.

But before any large quantity of water can be diverted from the Sacramento River, Shasta Dam must be in operation so as to regulate the Sacramento's flow and assure a year-round water supply for the various project uses.

Likewise, Shasta power will be needed to operate the pumping plants of the delta canals. Thus it is evident that except for the possible use of certain purchased water, normal operation of Friant Dam and the Friant-Kern and Madera Canals cannot begin in earnest until the *entire* Central Valley project is completed.

The statement has been made that, although the Central Valley project was initiated as a water project, the Government now has turned it into a power project. No change has been made in the plan of the project. It always has been both a water *and* power project—for in a reclamation undertaking of this magnitude water and power are Siamese twins, complementary and inseparable. Water requirements come first, but the power makes it possible to bring water at a price farmers can afford to pay. Without power revenues, there would be no Shasta Dam and, consequently, little hope of relieving San Joaquin Valley of its water shortage.

There is now pending before the Congress at Washington a budget estimate for an appropriation to begin the installation of a steam plant at Antioch. This steam plant is an essential feature of the Central Valley project. It has been contemplated since the project was first conceived and now, because of war conditions which make large blocks of power necessary for defense industries in this area, it is doubly necessary. From the standpoint of the Nation's security in its hour of peril and from the long-range point of view this steam plant should be welcomed by the irrigationists and other well-wishers of the Central Valley project.

The steam plant, in emergencies or low-water periods in the Sacramento, will save water for irrigation. It will increase the output of firm power from the Central Valley system to the point where in 40 years it will pay for itself and leave a margin of $75,000,000 to $83,000,000 to be applied to costs of the projects which otherwise will be borne by irrigators or other interests largely in the San Joaquin Valley.

The Central Valley project was authorized in 1937 by Federal law for the purposes of providing river regulation, navigation improvement, flood control, irrigation, salinity control, domestic and industrial water supplies, and electric power. That authorization still stands, and can be amended only by act of Congress. The effect of the war has been to change only the timing—to speed up the availability of the power—not to change the order of the ultimate objectives.

The growth of almost all the West since the days of the gold rush has been keyed to its irrigation development. Experience shows that property values may be expected to increase $4 for each dollar spent for Reclamation works. Great dams such as Boulder, Grand Coulee, Shasta, and Friant symbolize to the world the resources and strength of America. The areas under these projects have a manifest destiny of wealth and well-being which will not be denied.

A Swarm of Bees in May

"A swarm of bees in May
Is worth a load of hay;
A swarm of bees in June
Is worth a silver spoon;
A swarm of bees in July
Is not worth a fly."

By **WILLIAM E. CORFITZEN**

SO GOES AN ADAGE of the old time beekeepers, not without a certain amount of sense in the year 1942.

Any beekeeper can attest to the fact that the earlier in the spring that bees can be established in a hive, the sooner they will begin to gather honey and, having a long working season before fall arrives, the larger the stores which will be laid away.

Farmers have found that beekeeping produces numerous profits other than honey. The uninitiated naturally thinks of golden brown pancakes with honey to match on cold frosty mornings. This would seem to be sufficient justification for most farmers to try raising some bees during the coming season. But that is only one of the many advantages to be gained.

Bees are of great value to the farmer in pollenating his crops. This service cannot be evaluated in dollars but may be of greater value to him than the value of the honey collected.

Orchardists have long realized that several hives of bees scattered throughout an orchard when trees are in bloom will increase the yield of fruit. So important is that to many growers that they rent hives of bees for the short period that trees are in bloom. As soon as the blossom season is over, the owner takes his bees, his stipulated rental, and also the honey which was gathered from the orchard.

Increased yields are not alone confined to fruit crops. All crops show larger yields after bees have worked over the blossoms, extracted the nectar and distributed the pollen. Wind assists in distributing pollen but not nearly so effectively as bees, which carry the grains directly from one flower to another.

People in all walks of life have found honeybees an ideal hobby. Bees need little attention, in fact, produce larger amounts of honey when let alone. When disturbed they are inclined to feel that they are about to be robbed, and immediately each bee drinks all she can in order that the robber will have less. This, however, has an interesting effect upon the bees. As they become full, like people, they become lazy and in better humor. The beekeeper takes advantage of this fact to do the necessary work around the hive.

The organization of a hive is a revelation to all who take time to study these insects. The population of a hive consists of one queen, a few hundred drones or male bees and several thousand workers or infertile females.

Let us look at the usual life of a hive of bees for one year, beginning our observation some cold bright fall day. The goldenrod, aster and other late flowers have been caught by the first frost and are wilting. No honey is available and the bees seem to realize it is useless to fly very far from home. They take short flights around the hive, returning inside to get warm.

Within the hive the bees have gathered themselves together into a mass which is very inactive. They move slowly and lack the desire to attack intruders, a characteristic common in the summer.

As the days get colder the bees gather themselves together into a compact bundle which at first sight appears to be a large brown mass of dead bees near the center of the hive clinging to each other in a death grip. Closer observation discloses that the mass moves. Bees on the outside of this mass are gradually moving into the center while those from the center are moving out. Body heat from the bees permits them to maintain a temperature of over 90° in the center of this bundle. By constantly moving, the bees from the center exchange places with their near-frozen sisters on the outside. This phenomenon continues all winter, during which time the bundle slowly moves to new positions on the honeycomb in order that the necessary food can be acquired.

As the first days of spring approach, the bundle spreads out and becomes more active. Cells from which honey was taken during the winter are cleansed and placed in readiness for another supply. As soon as pollen and honey are available in the field the bees begin gathering. The queen realizes that her old worker bees cannot stand the strain very long and immediately prepares to raise a new army. During the inactive winter season worker bees may live for 8 months, but during the working season their lives may be only 4 or 5 days, as they actually work themselves to death in order that stores may be available for the coming winter.

The queen can lay up to 3,000 eggs per day which must hatch and pass through a larva and pupa stage before the young bees emerge from the cells. Thereafter they remain in the hive for about 10 days caring for other bees about to emerge. Then they begin to try out their wings and soon lend their labors to that of the family unit.

If the number of young bees and large amounts of honey within the cells result in overcrowding, the worker bees will enlarge a few of the cells into which the queen has already deposited her eggs. Special care and food will be accorded these chosen cells until in 25 days they produce young queen bees. These royal insects require an incubation period of 4 days longer than that of the workers.

Swarm!

The young queens will immediately engage in battle with each other until only one remains. The mother queen will then leave the old hive with a swarm of her loyal subjects in search of a new home. Should this swarm occur in May or June, the farmer who finds them on a bush or branch of a tree is lucky indeed, for he may capture them, put them in a new hive, and probably obtain a fair quantity of honey by the end of the summer.

The young queen who found herself in a well-equipped household with an army of workers emerging daily and plenty of food must immediately prepare to carry on her royal duties. About 10 days after emerging from the cell as a new-born queen she flies forth on a voyage to meet and mate with one of the drones. This act accomplished, she is impregnated for life and returns to the hive from which she will never leave except to swarm.

The life of the hive then returns to normal and the young queen starts laying eggs. The honey flow will vary with the amount of flowers available until fall when they will again settle down for winter.

During the working season guards may be seen stationed at the hive entrance who will admit bees from that hive and attack those from other hives. Other bees may be seen in the hive facing the entrance with their wings rapidly vibrating drawing air into the hive. Others will be seen within the hive, standing still but forcing the current of air along by vibrating their wings, thereby maintaining a constant temperature within the hive. On cold days other bees, particularly young bees which have not yet learned how to fly, will be massed over the cells containing the eggs, larvae, or pupae, thereby assisting the incubation by furnishing warmth from their own bodies.

The drones may be used to supply warmth to the hive for a while, but are disposed of as quickly as possible after the queen has been impregnated. Drones are larger than the worker bees, make considerable noise around the hive, eat a large amount of honey, but serve no other purpose than to mate with the queen. They produce no honey and do not sting. The worker bees dispose of them by stinging them to death.

Because of sugar and wax the Government has accorded the beekeeping industry a high priority rating this year.

The Yakima Ridge Canal Wasteways

on the Yakima Reclamation Project, Washington

IN ANY LONG side-hill canal (such as the Roza division main canal, Yakima project, Washington, approximately 100 miles in length) a break would cause serious damage if the only point of control were at the headworks. The entire intervening column of water would be free to flood the land under the break. To minimize this danger a series of wasteways extending from the Yakima Ridge canal to the Yakima River has been constructed. The wasteways also safeguard the canal against possible overload from cloudbursts or a power failure on the many pump lifts.

FOUR WASTEWAYS are in operation on the Roza division of the Yakima project with a planned construction of three or possibly four more. The wasteways represent an investment of $855,873. They involve 8 miles of varied construction.

Wasteway No. 1 is located at mile 3.5 (all mileage is measured from the Roza diversion dam) just above the Pomona siphon which carries the Roza water under the Yakima River 7 miles north and 1 mile east of Yakima. This wasteway is of very simple construction—a chute in the side of the bench flume, or open top box section of the canal.

The capacity of the wasteway is 2,100 cubic feet per second or 942,550 gallons per minute (448.8 gallons per minute equal 1 second-foot), the quantity that would flow normally in the canal at full operation. The return to the river is made in a rock-riprapped section about 300 feet long.

The cost of wasteway No. 1, which was not constructed separately but as an integral part of the canal, was approximately $20,000.

From wasteway No. 1 the main canal winds through the East Selah and Pomona districts in lined and earth sections to tunnel No. 3 which passes under the Yakima Ridge. In this stretch there are 274 acres under gravity distribution.

Wasteway No. 2 in the Terrace Heights district, a suburb east of Yakima, is perhaps the most interesting of the Roza wasteways constructed to date. The initial fall is greater and a larger variety of structures, 12 in all, 9 crossings, and 3 wasteway structures were required in the 1.1 miles of construction.

By **E. C. KEELER**
Assistant Engineer

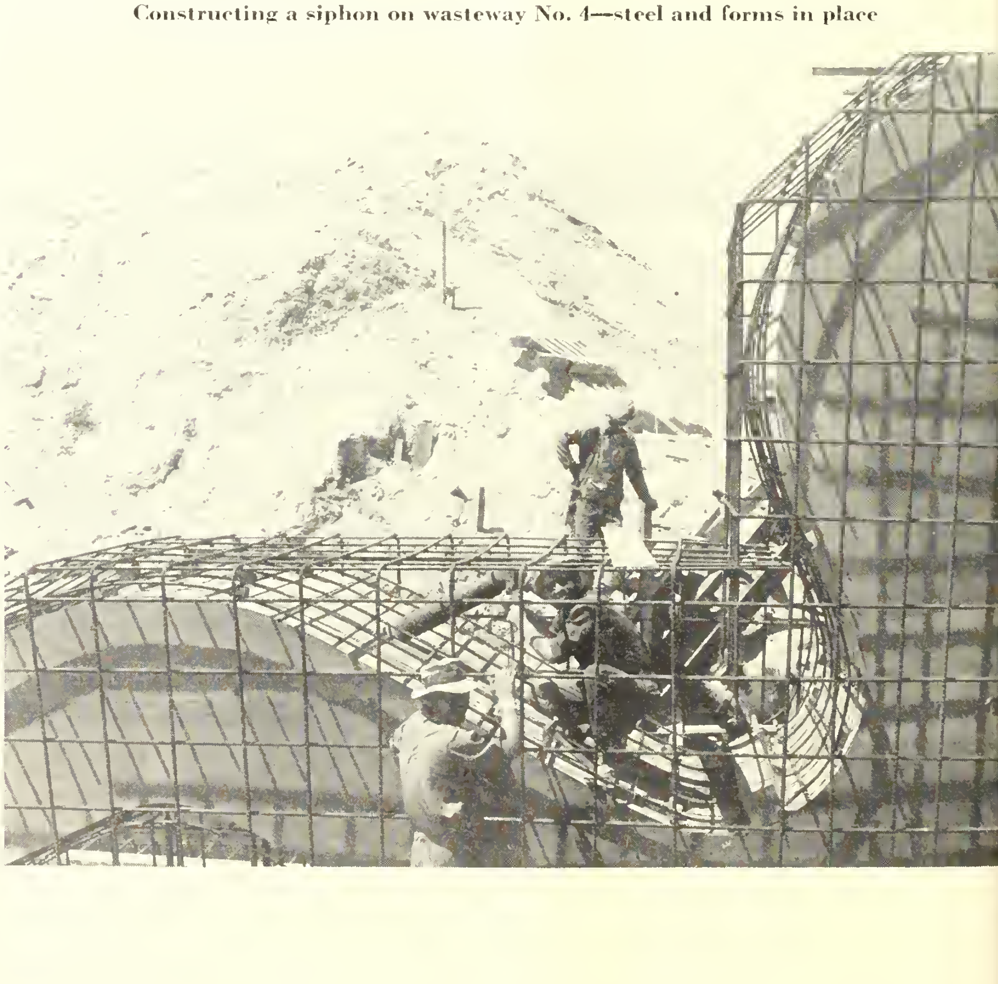
From the south portal of tunnel No. 3 a trapezoidal section 14 feet wide at the bottom and 13 feet deep with 1¼ to 1 side slopes, making it 46 feet 6 inches wide at the top and lined with reinforced concrete 4 inches thick, carries the 2,100 cubic feet per second to a Y with the main canal check of two radial 12- by 9-foot 6-inch gates ahead and the wasteway proper turning to the right some 750 feet to the transition and check located at the top of hill. This check structure utilizes two similar radial gates with two 2-foot 2-inch by 5-foot gooseneck siphons built into the concrete structure on each side of the gates providing the automatic spillway feature.

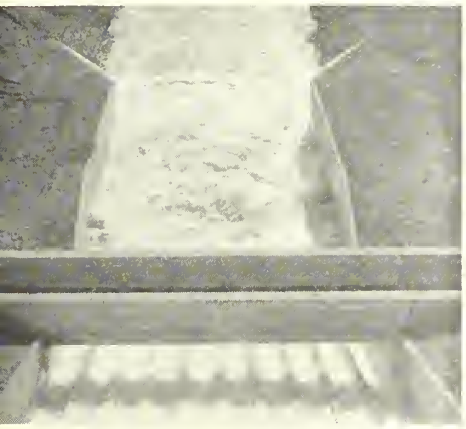
From this check, which overlooks the Yakima River and the city of Yakima to the west, a rectangular section 10 feet wide and 6 feet deep constructed of reinforced concrete 6 inches thick drops abruptly 160 feet in 353 feet, a grade of 45.22 percent to the stilling pool below, passing successively under the following constructed crossings: the Selah-Moxee Canal (concrete flume) (a small private ditch), a timber county road bridge and the Moxee Co. concrete flume (another small private ditch). Starting under the county road bridge are 9 tapered longitudinal vanes which in 136 feet guide and spread the water to a 40-foot section at the bottom of the incline in the stilling pool.

The stilling pool itself begins 31 feet back from the bottom and is 20 feet deep and 40 feet wide with battered walls and variable thickness floor. The velocity of the water is broken partly on itself, as there is normally 10 feet of water in the pool, and partly on eight baffle blocks and a still at the beginning of the transition from the pool to an earth section ahead. In the partial test with approximately 500 cubic feet per second, the stilling pool operated very satisfactorily.

Ahead of the transition an earth section 30 feet wide at the bottom by 15 feet in depth, with 1½ to 1 side slopes, extends 0.86 mile to the Yakima River. This section is

Constructing a siphon on wasteway No. 4—steel and forms in place





00 cubic feet of white water per second foaming down wasteway No. 2

panned by the six remaining constructed rossings—three ditch, two road, and one ailroad.

The contract for the construction of waste-ray No. 2 was $206,467 or $164,500 per mile.

Power Possible on Wasteway No. 2

As a possible future development 900 cubic eet per second can be made available at the heck of wasteway No. 2 for the generation f approximately 10,000 kilovolt-amperes of lectric power, and thus contribute to the rigation of the Roza lands above the main anal by being utilized at the various pump-ng units under consideration.

Below wasteway No. 2 the remaining 1,300 ubic feet per second is carried by bench ume, lined canal and earth section through he Terrace Heights district east of Yakima, growing residential suburb and orchard ection, to the Moxee Valley famous for its ops, and thence in tunnel No. 5 under the Rattlesnake Hills 18.22 miles farther to mile 9.10 which marks the beginning of the check nd spillway of wasteway No. 3. In this ection the amount of land irrigated by Roza gravity is approximately 2,700 acres.

Wasteway No. 3, 3.65 miles in length, is esigned to carry 1,252 cubic feet per second nd is equipped similarly to wasteways 2 nd 4 with two radial gates for the main anal check and two slide gates in the spill-way as well as a single automatic siphon f 160 cubic feet per second capacity.

Wasteway No. 3 is composed of several ypes of sections, the first of which is a re-nforced concrete trapezoidal design extend-ng some 1.87 miles through rolling sagebrush and to the succeeding rectangular section which continues on 5.5 percent and 2.5 per-ent grades for 0.39 mile to the top of the ill overlooking the cultivated valley below. Here the slope is sharply accelerated, drop-ing 139 feet in 621 feet, on a grade varying rom 19.59 to 26.46 percent in a similar rec-angular section. On this slope the wasteway asses under two irrigation canals, the first bout midway is the timber bent metal flume conveying the Union Gap private canal and the second at the bottom is the Sunnyside earth section of 1,052 cubic feet per second capacity, underpassed in a broken-back rein-forced concrete box culvert 187.5 feet long.

After passing under the Sunnyside Canal, wasteway No. 3 continues in a trapezoidal section similar to that previously described across a gently sloping section of improved land devoted to hops and fruits for 0.65 mile, where it again enters a rectangular section and crosses under State Highway No. 3 (U. S. No. 97), and enters the stilling pool and rail-road crossing which, with the transitions, completes the concrete lined section of 3.1 miles.

The stilling pool, built to check the velocity of the water, is a rather massive reinforced concrete structure 155 feet long varying from 12 to 22 feet in depth and 13 to 23 feet in width. This structure is followed by a 146-foot reinforced concrete box which passes un-der the Zillah Branch and Sawyer Siding of the Northern Pacific Railroad and the Union Pacific branch line railroad. The remaining section of the wasteway is of earth 11 feet deep with a bottom of 35 feet and extends through wastelands 0.34 mile to the Yakima River.

Wasteway No. 3 cost $336,534, which for the 3.65 miles would average $92,200 per mile.

This wasteway when tested with approxi-mately 500 cubic feet per second performed very satisfactorily. The waves forming at the transitions from trapezoidal to rectangu-lar sections at lower capacities smoothed out as the larger flow was reached, and ample freeboard was in evidence at all sections and structures.

From wasteway No. 3 the main canal with a capacity of 1,150 cubic feet per second con-tinues in earth and lined sections past tun-nels Nos. 7 and 8 and siphons Nos. 2, 3, 4, and 5 through 11.63 miles of raw sagebrush land, serving 5,815 acres by gravity distri-bution, to mile post 40.73, the present end of the completed main canal construction and the beginning of wasteway No. 4, ap-proximately 2 miles east of Zillah. Beyond this point work is proceeding on two main canal contracts which will extend the project to wasteway No. 5 at mile 50 above Sunny-side. Work on the gravity lateral distribu-tion system is also under way under the first of these contracted sections.

Wasteway No. 4 the Longest

Wasteway No. 4 with a capacity of 1,050 cubic feet per second, the latest of the Roza wasteways to be constructed, is also the long-est to date. From the main canal check the section is continuously rectangular to the outfall, a distance of 3.23 miles, broken only by the Sunnyside Canal undercrossing and the highway and railroad crossing.

At the check structure radial gates check the flow in the main canal while the waste-way is controlled by two slide gates, both electrically operated. The automatic siphon is a single gooseneck of 150 cubic feet per second capacity built monolithically into the wasteway structure.

Below the check a rectangular section falls 256 feet in 1.75 miles through sagebrush land to the Sunnyside crossing. This major struc-ture, a reinforced concrete box culvert 266 feet long, 5 feet deep, and 10 feet 6 inches wide passes under the Sunnyside Canal to the orchard lands and the cultivated fields below. Following a natural draw the waste-way continues in a similar rectangular sec-tion passing under three constructed timber bridges in the 1.32 miles to the highway and railroad crossing. This crossing, unlike Wasteway No. 3 where the highway is bridged separately, passes under the same State High-way No. 3 and the same Northern Pacific and Union Pacific Railroads in one continuous 193-foot reinforced concrete rectangular box culvert.

Wasteway No. 4 cost $292,590, averaging $86,600 per mile for the 3.4 miles.

The $855,873 cost of the 4 wasteways repre-sents approximately 10 percent of the $8,272,-172 cost of the project to and including Waste-way No. 4. When the ever-increasing returns of the lands coming under irrigation on the project are taken into account, the construc-tion of these wasteways is a justifiable in-surance that there will be a minimum interruption of production.

Questions . . . Questions

KEEPING A STRAIGHT FACE when visitors ask questions like "Is the water any good for irrigation after they take the electricity out of it?" is one of the accomplishments of the vista-house lecturers at Grand Coulee Dam.

Most visitor questions are quite intelli-gent. Regardless of the inquiry, informants have been trained to return a polite answer.

Some of the questions:

Are they going to build the dam clear across the river?

If this dam is being built for flood control, why wasn't it built on the Mississippi?

Which side of the river are they building the dam on?

What's the name of this river? Is it the Columbia River? Well, then what is the name of the river on the other side of the dam?

Is the river water salty?

Was there a river here before the dam was built?

Mister, how does one go about buying some shares in this dam?

One visitor traveling via bus delayed his return 12 hours because, he said, he wanted to see what the dam looked like when the tide came in.

Indians Clear Reservoir

By **D. L. BRECHNER**

WHERE ONCE their ancestors stalked antelope and bear, Wacksache Indians are wielding the white man's ax and saw. They are helping to clear trees and brush from the reservoir site for the new lake to be created by Friant Dam, Central Valley Reclamation project, California.

James Osborne, full-blood Wacksache, heads a clearing crew of nine of his tribesmen, supplemented in summer months by his two sons of high-school age. He was the low bidder for two of the Millerton Lake clearing contracts. In June 1941 he was awarded a contract covering the clearing of trees and brush from 50 acres of the reservoir area. When this job was done late in September, he started work immediately on a tract of 245 acres on which he was the successful bidder.

James Osborne's home is in Squaw Valley in the Sierra-Nevada foothills about 30 miles east of Fresno, Calif. He has worked in timber most of his life, is an expert axeman and adept at setting and sharpening saws.

Not all of those who have clearing jobs on Millerton reservoir are Indians. But Osborne's contracts typify the practice followed on the Friant Division of the Central Valley project of advertising for clearing bids in small tracts to permit local people with small capital to share in the great construction program. Most of the clearing contractors are residents of the foothill communities of Madera and Fresno Counties.

Indians at work and at home, on the site

Carrol G. Page, for instance, was the low bidder on two adjoining tracts comprising a total of 290 acres, and with David Snavely and Edward Grossen offered the low bid for the first clearing contract awarded. Page owns a general store and filling station at Prather where he is also the postmaster. Besides giving attention to his other affairs he finds time to spend 2 or 3 days each week with his clearing crew where he swings an axe as a slasher and operates the small "cat" used in snaking pine logs to burning piles and oak logs to locations near access roads where they are sawed into stovewood lengths and hauled by truck to retail firewood dealers in Fresno. As is common with all the contractors' crews, the men in the crew have worked in timber all their lives and can double as fallers, slashers, and buckers. Page employs 18 men, about half of whom are Indians.

Victor Hugo, a mechanic from Friant, is another successful bidder on the Millerton job. He also sublets the actual work of clearing under a provision for retaining the firewood. He cuts the wood into stove lengths with a tractor-mounted buzz saw. At prevailing prices the wood brings a gross return of $12 per cord delivered in Fresno.

Breckenridge Brothers of Sanger hired a seven-man crew to clear a 50-acre tract they had under contract on the north side of the San Joaquin River. They and their men commuted from Sanger to the Fresno County side of the river and from there they ferried to the north side on a raft. The Breckenridges formerly were engaged in clearing operations in Mississippi.

W. A. Dees of Fresno is working a 60-acre tract as a family affair, using no outside help.

Local People Awarded Contracts

Twenty-eight contracts covering 3,552 acres were awarded by the Bureau of Reclamation to local people from the time clearing operations started in June 1941 to the end of January this year. Eight jobs remained unawarded. The tracts range in size from 38 acres of heavy growth on rugged terrain to 512 acres of open country covered by scattered trees and brush.

The total area to be cleared from the future Millerton Lake comprises 3,900 acres lying between elevations 400 and 583 above sea level. The 600 acres below elevation 400 will not be cleared. The deadwater storage level is at 380 as determined by the river outlets, but the water surface of the reservoir is expected to seldom go below elevation 400 because the lowest canal outlets in the dam are at 446.

Young but lusty and growing—the new lake

The practice of advertising work in small schedules is Reclamation policy to offer opportunities to local people in project areas. Direct benefits are reaped by 300 local people from the Millerton clearing job. It has been followed in canal construction and other jobs, but this is the first time the plan has been applied to extensive reservoir clearing.

Another consideration involved at Friant was the belief that competitive bidding on small tracts would enable clearing work in this particular section of the country to be accomplished at a cost substantially lower than if the entire area was advertised in one or two tracts. The cost per acre for the area already under contract has confirmed this.

The clearing of Millerton reservoir site has no unusual problem. Requirements conform to standard practice. All trees, stumps, and brush more than 5 feet high having a diameter at the butt of more than 1 inch are cut. All combustible materials are piled for burning as directed by the contracting officer. The specifications provide, however, that the contractor may retain timber of value for his own use or disposal providing it is removed from the reservoir area prior to the date fixed in the contract for the completion of the work. There is no saw timber in the entire area but some of the trees are being cut into firewood. The growth cleared from the site is digger pine, white oak, live oak, manzanita, and other brush.

During the wet season from December until late spring whenever weather permits burning operations are carried on by a Bureau burning crew. During the remainder of the year it is necessary to have a burning permit from the State fire warden's office, and operations are carried out under the supervision of a State fire suppression crew. Whenever possible material to be burned is piled in deep eroded ditches. The ditches have good draft and their steep sides eliminate chunking-in which on level ground is necessary for complete combustion.

NEWS OF THE MONTH

By WALTER K. M. SLAVIK, *Chief, Editorial Section*

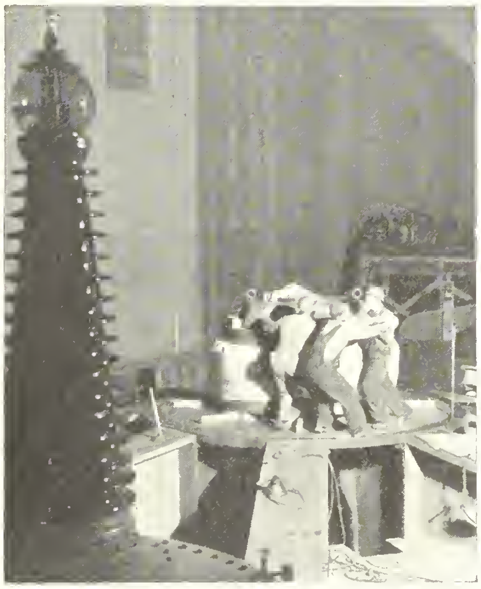
On Tap!

MORE THAN 5,000,000 kilowatts of hydroelectric power for Pacific Northwest industry, with 3,000,000 to 4,000,000 kilowatts within 4 years, are potentially available for immediate development in this country's war effort, according to an interdepartmental Federal board composed of representatives of the Federal Power Commission, the War Department, the Department of Agriculture and the Department of the Interior. The Board's program proposes the expansion of facilities at Grand Coulee and Bonneville Dams, bringing in 860,000 kilowatts, and 10 new Northwest hydropower projects, bringing in 4,291,000 kilowatts.

FORMED TO MOBILIZE Interior Department strategic resources—ores, minerals, metals, power, oil, coal, industrial and domestic water supplies, food crops and timber—the members of the War Resources Council of the Department of the Interior are Michael W. Straus, Director; Stephen Raushenbush, Chief, Branch of Planning and Research, Power Division; William E. Warne, Chief of Information, Bureau of Reclamation; Joel D. Wolfsohn, Assistant Commissioner, General Land Office; John C. Page, Commissioner, Bureau of Reclamation; Abe Fortas, Director, Division of Power; R. R. Sayers, Director, Bureau of Mines.

NEW LEGISLATION has been submitted to Congress which may have been enacted into law to curb land speculation on the Columbia Basin (Washington) project as this appears in print. Important sections of the bill, which replaces the Anti-Speculation Act of May 27, 1937, include Government authority to buy privately owned land at appraised values, sell the land to settlers in platted tracts, improve the tracts by well drilling and construction of farm buildings and fences, and lend money to settlers to establish themselves in their new farm homes.

AN AIR-RAID SIREN of 7½ horsepower, one of the largest obtainable, has been installed at a strategic point near Grand Coulee Dam to warn project workers and people residing in towns near the project of an impending attack. Its installation is one of the many protective measures the Bureau of Reclamation is taking to safeguard the dam and powerhouse. Grand Coulee generators are delivering a large block of electrical energy to industries on the lower Columbia River producing materials of war.



Tightening the thrust collar on the 200-ton steel shaft for generating unit L–1, newest power producer at Grand Coulee Dam, scheduled for completion this month

CAPACITY of the Delta-Mendota Canal on the Central Valley (California) project may be 4,600 cubic feet a second, making it one of the largest canals in the world, capable of carrying 2,000,000 gallons a minute, enough to fill the daily requirements of three New York Cities. The capacity was approved with the understanding that the water in excess of basic requirements mainly for replacement at Mendota Pool will not be used to serve new lands in the San Joaquin Valley if the water is necessary for development in the Sacramento Valley below Shasta Dam and in the counties of origin of such waters. The Delta-Mendota Canal shuttles Sacramento River water from the Sacramento-San Joaquin delta to the Coast Range foothills 110 miles south.

THE WAR Production Board is working with the Bureau in an endeavor to speed power installations on Reclamation projects to the fullest possible extent.

SWISS CHEESE is Cache County's (Newton project, Utah) newest industry. The first milk for processing at a new cheese factory in Amalga (Utah) was received this year. The capacity of the factory is 30,000 pounds of milk a day. Capacity can be tripled readily, Resident Engineer I. Donald Jerman reports.

AMERICAN RIVER investigations on the Central Valley (California) project are continuing as a possible source of water for the project.

EVERY CENT of its indebtedness—$350,000—has been paid within 10 years by the Central Oregon Irrigation District, collecting its own water assessments beginning 1931 when authorized to do so by the State legislature. Simultaneously with clearing off its debt the District within the decade also reconstructed the distribution system, rebuilding main flumes of concrete and steel wherever possible, bought a dredge, caterpillar tractor, bulldozer, carry-all scraper, compressor, and two trucks (in 1932 the District had only one truck and little other equipment), and lowered the cost of irrigation water from a top of $2.65 to $1.70 per acre-foot.

EXCAVATION is in progress for a large fabricating and equipment storage plant at Grand Coulee Dam to be used to assemble parts for powerhouse turbine-generators. As more turbine pits are equipped less room is available in the west powerhouse for the assembly of parts for the 1,750-ton hydroelectric sets. Additional assembly space had to be provided to speed erection. Sandblasting and painting of scroll-case parts will be done in the plant, which will be 200 feet long and about 75 feet wide. Steel from the old Great Northern Railway bridge at Marcus, now being dismantled, will form the frame for the structure. It will have corrugated metal siding.

EAST PARK RESERVOIR on the Orland (Calif.) project is practically full and Stony Gorge can be filled at any time by raising the spillway gates.

APPRAISALS of irrigable land on the Columbia Basin (Wash.) project have been completed. About 70 percent of the 1,209,909-acre project area ranges from $1 to $10 an acre, about 30 percent from $5 to $30 an acre. The average appraised value per acre of the project area was $8.18 without improvements, $11.05 with improvements. Valuation for the entire irrigable project area, land only, will fall between $13,000,000 and $14,000,000; including improvements, between $18,000,000 and $19,000,000. Appraisals were made of each 40-acre or smaller (where subdivided into smaller farms by platting) tract. About 44,000 separate investigations were made during the 3 years, 3 months of appraisal work.

Safe Back Home Again

SAFE back home again in the Denver Office after a flying trip to aid the Australian Government as a consultant in dam construction, Chief Designing Engineer John L. Savage is understood to have spent more than a month on the high seas returning to this country. Like aid by Mr. Savage to the East Indian Government was prevented by the outbreak of war in the Far East. He left Denver November 5 and the Japanese attacked the Hawaiian Islands only a few days after he had stopped at Honolulu en route.

INQUIRY has been received by the North Platte (Nebr.-Wyo.) project as to power available for army training facilities at Fort Warren and a magnesium plant at Thermopolis or Cody, Wyo.

ABOUT 1,000 acres of farm land on the Buford-Trenton (N. Dak.) project have been leveled and 1,500 acres cleared by FSA, 2½ miles of farm roads built, and nearly 4 miles of drains installed. Clearing and drain installation are most advanced; they are a third complete.

QUICK PROGRESS is being made on Anderson Ranch Dam in Idaho—highest earthfill (444 feet) dam in the world—the diversion tunnel has been begun, stripping has reached sound rock at the right abutment, and solid rock has been reached in excavation for the spillway.

NEARLY 40 MILES of core were drilled at Grand Coulee Dam by Lynch Bros. of Seattle, core-drill company that started work at the dam site on September 18, 1933, and finally finished its job recently.

The company drilled 21,200 linear feet of holes for the old Columbia Basin Commission, a State organization in charge of early construction; about 20,000 feet for the Mason-Walsh-Atkinson-Kier Co., builder of the foundation for the dam; and 167,800 feet for Consolidated Builders, Inc., present contractor, for a total of 209,000 feet or about 39½ miles.

The first drilling was in the Columbia River and along the shores at the dam site. Some holes punctured the granite for 800 feet. This work was for the purpose of establishing the general elevation and possible continuity of bedrock, and also to gather sufficient data on which to base dam designs and compute construction quantities.

A LARGE FEEDING PLANT is under construction at Malin on the Klamath (Oreg.-Calif.) project to accommodate 4,000 to 5,000 head of feeder cattle in the yards. Loading chutes, scales, and a modern mixing and grinding mill are included in the new plant which is expected to be completed this month. Local hay and midwest corn will be fed the cattle.

A MILLION DOLLARS in transportation charges would be saved future residents of the Columbia Basin (Wash.) project by using the Columbia River as a commercial route, if improved for navigability as recommended by the report on Problem 21 of the Joint Investigations on the project.

NOT BARRED from the Grand Coulee Dam area is the general public, despite rumors to the contrary. Although the dam and power plant are under heavy guard, visitors may drive to within a few hundred feet of the world's most colossal structure and also visit the vista houses and model rooms. Visitors at the dam last year numbered 323,380, gaining over 1940's 322,090. The total since 1933 (to the end of 1941) has been 1,651,019. At that time the working model of Grand Coulee Dam, which shows water flowing over the spillway and passing through the powerhouses and pumping plant, went through its 5-minute cycle 118,000 times. The model is automatically operated.

MORE THAN 1,100 carloads of farm products were shipped out of the Boise (Oreg.-Idaho) project in one month (November) last year. Sugar beets accounted for 539, lettuce for 245, cattle for 61, canned food for 36.

The Stars Help

THE STARS help Grand Coulee Dam powerhouse operators keep the electric clocks correct in homes and industries of the Pacific Northwest serviced by the Grand Coulee-Bonneville system. A large master clock whose accuracy is checked periodically through Naval Observatory time signals, calculated from the relative positions of the celestial bodies, governs the regulation of the frequency of the Government network. A powerful 15-tube radio set picks up the notes broadcast by the far-away station. The time signals are said to be accurate to a very small fraction of a second, as exact as man is able to gage time.

ALL AVAILABLE FARMS on the Bitter Root (Mont.) project are expected to be in cultivation this year. Prices for crops and livestock are reported good.

PROGRESS is reported on Box Butte Dam construction on the Mirage Flats (Nebr.) water conservation and utilization project despite bad weather the first part of the year. Concrete has been placed in the spillway stilling pool.

MORE THAN 300 Grand Coulee Dam employees have been graduated from Red Cross first-aid courses since the Bureau of Reclamation undertook to conduct its own safety program on April 16, 1940. Consisting of 271 Government workers who took the standard first-aid course and 44 who completed the advanced work, the 300 do not include those who received their first-aid work from the contractor's safety department prior to the inauguration of the Government safety campaign nor Government employees who received their work in other localities within the Columbia Basin project. These groups total approximately 80 employees. Twenty-seven children completed junior work.

ENGINEER C. W. Burningham, in charge of field surveys at Grand Coulee Dam, has been placed in charge of the Trinity River investigation, Central Valley project.

"Dynamos" and "Beavers"

APPROPRIATELY enough the town basketball team at Grand Coulee Dam is known as the "Coulee Dam Dynamos." Equally fitting is the sports name of the athletic teams of Mason City High School, the "Beavers."

BOTH FORKS of the Shoshone River carried more water than usual last winter, forming large ice gorges in the channel below Willwood Dam and above the Big Horn. Kane and Lovell residents were reported expecting spring floods as a consequence, especially if the river ice broke up first in the upper part.

LINING Heart Mountain canal on the Shoshone (Wyo.) project with bentonite, the "swell" impervious clay discovered not so long ago, CCC boys are doing well. A processing plant has been erected and a road built to reach the bottom of the canal, between mining and drying the bentonite.

THE KINGS RIVER (Calif.) investigation is moving along. A theoretical operation of Pine Flat reservoir through 45 years of stream flow record has been completed. Definite storage space in the reservoir has not yet been allotted any irrigation area.

Priority for Farmers Too

PRIORITY is available for farmers, too, for the repair and maintenance of their farm machinery, announces the War Production Board. An A–10 rating is possible for necessary repair materials from nuts and bolts to whole parts. The rating cannot be used for the purchase of new equipment, however, or its replacement in entirety.

FOR THE FIRST TIME in 17 years the Okanogan (Wash.) project is unconcerned about the coming season's water supply. Nearly 1½ years of abnormal precipitation has put storage in good shape, and this winter one of the heaviest snows in years fell on the higher mountains.

TWO-THIRDS of the 5.7 miles of tunnels (5) on the Tucumcari (N. Mex.) project have been bored through, reports Resident Engineer Harold W. Mutch.

CCC boys acquire some sun-tan preparing a canal for concrete lining

Lining Lateral Canals

Precast Concrete Slabs Used on Yuma Project

By
E. C. ROUNDS, E. L. FORTE *and* W. R. FRY, *CCC*

Civilian Conservation Corps boys contribute greatly to the construction of irrigation projects in the West. About 30 camps are assigned to Reclamation projects. Here the enrollees of one of them—BR-13, assigned to the Yuma Reclamation project—report on one of the many jobs undertaken by CCC forces.

THE YUMA Reclamation project grows crops all year round. Any canal lateral lining must be interrupted frquently to permit delivery of irrigation water to the farmers. Precast concrete slab lining is well adapted to interruption. This and other reasons such as satisfactory results from slab linings by the Department of Agriculture Experimental Farm at Bard, Calif., influenced the selection of precast concrete slab linings for the Yuma project.

The precast slab plant was located at the Bureau of Reclamation yards about 5 miles from our camp. It was equipped to manufacture the thin reinforced slabs and reinforced tile. It contained four rows of forms, each 4 by 6 feet, 15 forms to the row. The forms were of 16-gage galvanized iron attached permanently to the floor with side rails of 4-inch (50-pound) railroad rails fixed to break away from the concrete, to remove slabs. Partitions were 3 by 4 inches and made to member with the side rails, making an all-metal form 4 inches deep with a capacity of 15 slabs to each row. Each concrete slab weighs approximately 600 pounds.

In breaking the forms the side rails, which are continuous the length of the building, are moved out a proper distance to form a standard-gage track and held to place by blocks and lugs. These rails then connect with a standard-gage track leading to the slab curing and storage yard. A hand winch on a slab-moving car is run over the forms on the rails that were previously used as side members of the forms. This slab-moving car (worked by hand) picks up the slab, turns it over and transports it to the curing yard placing it back side up in order that the pans may be filled with water to help in the curing process.

After the canal to be lined is surveyed, running a center line and grade stakes, the floor is laid. The carrying capacity of the canal is the determining factor in establishing the floor width since the side lining is of uniform height for all laterals. The floor width may vary from 2 to 6 feet, the average being 3 feet. Margin stakes are then placed by the work crew allowing one or more feet on either side of the established floor width for working space. Necessary subgrading is then done in preparation for a gravel subfill 6 inches deep placed in the ditch bottom. In nearly all cases the old ditch section is more than ample in size to accommodate the lined section.

The floor slab is reinforced with ⅜-inch longitudinal steel placed at 12-inch centers. The crossbars, also on 12-inch centers, are slightly curved downward at the ends for proper clearance of the screed. Screeds are made by nailing a 1- by 6-inch strip to the 2-inch side of a two by four. They are set with the 6-inch side vertical and the two by four horizontal, which leaves a shoulder 2 inches below the floor level and 4 inches wide, forming the groove to carry the precast slabs. The floor slab is continuous and is poured in sections of considerable length, 400 to 500 feet per day.

In Use While Under Construction

When the floor is in, the canal may be used to irrigate between working hours of the crew with little or no damage to the sides or interference with the slab placing crews.

Slabs are loaded at the yard on the regulation stake truck by means of a derrick. Eight slabs are hauled to the load and are unloaded at the work project by hand, using removable skids affixed to the rear of the truck bed. The slabs are placed on the canal bank in pairs, the first or bottom one face side up, the one on top face side down. At every 13th pile four are unloaded to compensate for the space lost in distributing. Hauling of cured slabs to the job is carried on while the floor is being poured or while the crew is laying previously hauled slabs.

Putting on the finishing touches

The slabs are taken into the ditch on skids. The first one off the pile, face down, is placed in the groove on the opposite side of the canal. This brings the finished face or water side into place. This slab is then barred into position tight against the preceding one or the structure. The second slab is now face up and is placed on the near side of the canal opposite the first.

The slabs are held to slope temporarily by

See LINING CANALS, next page

A New Crane Prairie Dam

By **L. R. BROOKS**
Associate Engineer

The old name has been retained for the modern structure now functioning on the Deschutes Reclamation project.

THE OLD CRANE PRAIRIE timber and rock-fill dam built in 1922 on the Deschutes River in Oregon by private interests is gone—but a modern earthfill structure with the same name constructed by the Bureau of Reclamation now stores water for the irrigation farmers of the region.

The new dam is 36 feet high and 315 feet long. The upstream face is on a 3 : 1 slope to the foundation and is protected by 2 feet of dumped rock riprap. The downstream face of the rolled embankment is on a 1½ : 1 slope and is protected by dumped rockfill increasing uniformly in thickness from the crest to the foundation with the exposed face of the rock laid roughly to a 2 : 1 slope. The maximum toe to toe width of the dam is 200 feet.

All suitable material stockpiled from the outlet works excavation and from the spillway was used in the embankment and the additional quantity necessary was obtained from a borrow pit upstream from and above the right abutment. The soil used in the embankment consisted mainly of decomposed basalt and volcanic ash. Dry pumice was added.

There were sufficient suitable rocks in the stockpiles and in the borrow pits to complete the riprap and rock fill.

Low Rolled Embankment Included

In addition to the dam proper, a low rolled embankment was constructed along the right side of the spillway. A protecting blanket was also dumped over the face of exposed jointed basalt on the left bank of the river, extending from the left abutment upstream around the front of the spillway entrance. The outer face of this blanket was on a 2½ : 1 slope and was protected by 2 feet of dumped riprap. No roadway was provided over the dam and consequently no parapet or curb walls were constructed.

The dam's spillway is an uncontrolled open rock cut around the left end of the dam embankment and is designed to carry 2,500 second-feet of water with a depth of 5 feet over the spillway crest.

Excavation for the spillway was started in 1939 and the spillway was completed on July 26, 1940, with the placing of the concrete weir crest. The spillway excavation included 11,343 cubic yards of common excavation and 2,804 cubic yards of rock excavation. Paving along the sides of the spillway required the placing of 551 cubic yards of rubble concrete.

Vernon Brothers of Boise, Idaho, the contractor, began work on August 24, 1939, and completed the contract on August 15, 1940, in a total of 345 calendar days.

The leaking old Crane Prairie Dam constructed by the North Canal Co. in 1922 was located approximately 230 feet upstream from the new dam. The site for both takes advantage of a large open meadow and swamp, "Crane Prairie", draining through a narrow basalt gorge.

Sufficient clearance was allowed to complete the new dam before the old dam was removed, because the construction operations were not to interfere with the storage or use of irrigation water. When the new dam was completed sufficiently to allow the new gates to be used to regulate the discharge, the water was equalized on both sides of the old dam and the old slide gate was removed.

The timber portion of the temporary dam exposed above the water was saturated with oil and burned. The remainder of the structure was jarred loose with dynamite, removed by dragline, and the channel cleaned to the level of the weir crest above the fish screen. The removal of the old dam proved to be more of a job than anticipated because it was found to be constructed of 2- and 3-foot logs held together with ¾-inch drift bolts. The spillway was formed of planks spiked to the outside of the logs.

Before any work could be started on the new Crane Prairie Dam, it was necessary to construct the outlet conduit to divert the river. The outlet conduit has two 7-foot diameter horseshoe openings designed to carry 1,800 cubic feet per second at full reservoir and is 140 feet long.

Fish Screen Installed

A unique part of the outlet works is a specially designed fish-screen structure at the inlet end. The structure is 40 feet in diameter and 29 feet high above the floor. Twelve rectangular openings 7 feet 6¾ inches by 24 feet are provided to receive the trash racks, constructed of 2 inches by 5/16-inch steel bars set vertically on 7¼-inch centers. Galvanized fish screens with horizontal rectangular openings 3 inches by ¼ inch are bolted to the outside of the trash rack. The top of the fish-screen structure is level at elevation 4,450 and is the operating floor for the jib crane provided to handle the trash racks. At elevation 4,421 is a level concrete floor nearly surrounding the fish-screen structure, with a 3-foot weir wall at the outer edge constructed roughly in an arc from a retaining wall at the toe of the dam to a retaining wall at right side of the excavation. The area below this concrete floor is drained by means of 211 feet of 6-inch diameter open-joint concrete pipe drains.

The entire outlet works, including the fish screen and stilling basin, was constructed in a trench excavated in the left bank of the river. Excavation was started early in September 1939 and the last concrete, the floor slab for the footbridge, was placed on July 20, 1940.

The outlet works including the fish screen and stilling basin rest on jointed weathered basalt. The altered material had completely filled the joints between the blocks and no foundation grouting was considered necessary.

Stripping Started August 1939

Stripping and unwatering the dam foundation was started late in August 1939, but aside from stripping for the right abutment and for the outlet works excavation very little was done during the 1939 season. No further stripping was done until after the river was diverted through the outlet conduit on May 14, 1940, after which time stripping for the dam, consisting mainly of excavating the river bed wash to the tight claylike altered basalt and boulders was begun. Stripping for the dam and excavation of the cut-off trench was completed June 3, 1940. The cofferdam at the upstream toe leaked slightly but these seeps were stopped by placing a rolled section of fill directly against the cofferdam. No further unwatering was necessary after the water trapped between the upstream and downstream cofferdam was pumped out.

LINING CANALS *from page 89*

templates until sufficient backfill has been placed to substantially support them, after which the templates are moved ahead.

When the backfilling has been completed, water is turned into the lateral. As soon as the filled material has become saturated, a final tamping of backfill is performed to give finished alinement of the side walls.

No attempt is made to get watertight joints between slabs. The small amount of leakage is valuable in supporting weed competing grasses on the banks and in discouraging bank honeycombing by gophers.

In new work where the canal or lateral section could be excavated to neat lines, it is not believed that slab lining would be justified. On an old project where the existing ditch nection averages twice the size required for the replacing concrete section, and where numerous interruptions of the work are necessary to supply irrigation water, as on the Yuma project, precast slab lining works out very successfully.

Poultry Farming

on Pacific Northwest Reclamation Projects

By **DR. E. N. TORBERT**
Field Coordinator

POULTRY FARMING is more readily adjustable to a wide variety of natural conditions than any other type of farm economy on eight irrigation projects of the Pacific Northwest, according to a recently completed study by a committee of the Columbia Basin Joint Investigations.

The investigations seek to determine and to establish conditions for success of settlers on the 1,200,000-acre Columbia Basin project in eastern Washington, which will be irrigated by water taken from the Columbia River at Grand Coulee Dam. Study of farm economy on other northwestern irrigation projects was the first step in the investigations.

The projects and districts studied include the Vale and Umatilla projects, Oregon; the Owyhee project, Oregon and Idaho; the Boise and Minidoka projects, Idaho; the Yakima project and the Franklin County and Moses Lake irrigation districts, Washington. These projects and districts have some 14,000 farms totaling approximately half a million acres.

Poultry farming, the investigators found, is more prominent on the Umatilla project than on any of the others. On the Umatilla the average density of the fowl population in 1940 was 10 per acre, including 6 turkeys and 4 chickens. On the other projects this density was in every case less than 5 per acre, and, in most cases, less than 2. Poultry farming succeeded on the Umatilla project where natural conditions of soil and climate are unfavorable for many other types of farm economy.

Farms with sandy soil which is unsuitable for cash field crops are well adapted, it was found, to production of chickens and turkeys. Nearly all of the land on the farms studied where poultry raising predominates was planted to feed crops. Over 60 percent of the cropped area of the composite poultry farm (the average of all the poultry farms studied) is in hay, pasture, and clover. With an average of 1 acre per animal unit, the poultry farms appear to have good soil improvement programs.

Although the more successful poultry farmers on the projects studied have large flocks to which they give most of their attention, over 70 percent of all the farms of all types have some poultry included in the farm economy. This is another indication, the investigators found, that poultry raising is adaptable to a wide variety of conditions.

A great many farm flocks of 25 to 100 laying hens account for most of the poultry on the projects studied. These small flocks are usually cared for by the farmer's wife, and are fed almost entirely on products grown on the farm, some of which would otherwise be wasted.

When a flock consists of over 100 hens it is ordinarily considered an important phase of the farm program, and requires a regular part of the farmer's time. Such a flock in many cases is an adjunct of dairying. Among successful farmers the hens are well-housed and carefully managed.

The problem of feed usually is solved by growing a major portion of the requirements on the farm and by the use of skim milk. The Umatilla project is a notable exception. There an efficient, well established cooperative, operating in an important dry-land, grain-producing section, furnishes poultrymen and other livestock raisers with high quality feeds at relatively low costs.

Where all of the feed except the concentrates is grown on the farm, poultry advocates contend that the earnings are quite satisfactory. Farm programs on the projects surveyed, involving dairy cows and chickens, had an average of 80 laying hens per cow in 1940.

Dual purpose breeds are, in many instances, found in small farm flocks. They lay reasonably well, and make a better meat fowl, and are usually somewhat hardier than the best layers.

It is significant, however, that white leghorns comprise most of the large flocks of poultry specialists. One poultryman on the Sunnyside division of the Yakima project recently changed from 1,200 New Hampshire reds back to white leghorns. His verdict, after a 2-year trial, was that his dual purpose birds required one-third more feed (they weighed one-third more) and that they laid fewer eggs.

Poultry cooperatives handle a major part of the products exported from districts covered by this study. These organizations furnish reliable feeds, market the farmer's eggs and meat, and provide services effective in improving poultry management.

In examining the popularity of turkeys on farms of the eight districts, the investigators found that in recent years the tendency has been toward fewer but larger flocks. Most turkeys are now raised by men who make a specialty of the enterprise in areas where there is clean dry range. Sandy land is particularly desirable because it is relatively dry and disease control is simple.

Practically all turkeys raised on the Umatilla project are marketed through a cooperative association. The success of this association, which has a modern killing, dressing and cooling plant, is shown by the fact that it handled 50,000 turkeys in 1939 as compared with 8,000 in 1930. Approximately 80 percent of all the turkeys produced in the area are now marketed through the co-op. It is estimated that the difference in price paid by the consumer and that received by the farmer has been reduced from 20 to 6 cents per pound by the activities of the association. Thus the co-op, in effect, has put an additional profit of 14 cents per pound into the pockets of its members. Farmers receive 60 percent of the estimated market value when the turkeys are delivered and the remainder after the birds are sold.

On one turkey farm in the Umatilla project, the farmer either buys day-old poults or has his eggs hatched by a commercial hatchery. In the latter case, eggs from 200 of his best hens which he keeps as breeding stock for a flock of about 2,000 turkeys are stored and sent to the hatchery in lots of about 1,000.

Several farmers on new lands in the Boise-Owyhee area have used turkeys as a major enterprise during the development stage, keeping the flock on adjacent sagebrush range lands. Turkey raisers on the Umatilla project, where the soil is very sandy, keep their flocks on the farm, rotating their range from field to field of alfalfa. It is necessary to keep a herder with range turkeys at all times; consequently, flocks must be of considerable size if the undertaking is to be economically feasible.

Results of the study of farm economy on other northwestern irrigation projects are being used by another committee of the Columbia Basin Joint Investigations in formulating recommendations for types of farm economy on the various parts of the Columbia Basin project. Included in the work of the second committee is an exhaustive study of markets designed to prevent new production on basin lands from adversely affecting presently producing areas.

Reclamation Reading

ADVANCES IN ENGINEERING SEISMOLOGY. By N. H. Heck, Chief, Division of Geomagnetism and Seismology, U. S. Coast and Geodetic Survey, Washington, D. C.; Civil Engineering, January 1942, pp. 30–34.

BUREAU OF RECLAMATION EMPHASIS SHIFTS TO POWER FACILITIES. Treats of increased demand for electric power in West due to war industries. Western Construction News, January 1942, pp. 14–19.

WILL THERE BE ENOUGH POWER FOR DEFENSE.—Author predicts power-crises ahead. Speech in brief before AIEE in Washington, November 1941. By Leland Olds, Chairman FPC, Power, January 1942, pp. 84–86–7.

COLUMBIA BASIN PROJECT, WASHINGTON, CLEARING GRAND COULEE RESERVOIR SITE. The International Engineer, November 1941, pp. 152–154. Several thousand men and much equipment used to prepare the 82,000-acre Grand Coulee Reservoir for storing up 10,000,000 acre-feet of water to be released in driving up to 1,700,000 kilowatts in turbine-generator capacity. Gives facts regarding farms and villages moved to other sites due to rise of water.

CONVEYANCE LOSSES IN IRRIGATION CANALS. By E. B. Debler, Hydraulic Engineer, USBR, Denver Office. Civil Engineering, October 1941, pp. 584–5. Importance of irrigation water losses through arid lands of West; need of taking definite steps to collect and correlate data on this subject. Paper delivered at San Diego meeting in July 1941 ASCE Irrigation Division.

ELECTRIC POWER SUPPLY OF PACIFIC SOUTHWEST. By Lester S. Ready, Civil Engineering, November 1941, pp. 652–54. Review of existing supplies of electric power in California, Arizona, and Nevada, with additions now under construction. Paper presented originally before Power Division of ASCE meeting in San Diego, July 1941. Involves Boulder Dam.

MENACING LONG SERIES OF DROUGHTS. By Halbert P. Gillette, Roads and Streets, November 1941, pp. 48–60. Address to the National Reclamation Association, Phoenix, Ariz., October 17, 1941. Research in regard to "cycles" of drought in past, as shown in natural phenomena; and suggestions regarding the future possibilities of drought and ways of meeting; additional reservoirs, less water wastage, more extensive use of underground storage.

TECHNICAL MEMORANDA. No. 619. Trial Load Analysis of Nonlinear Stress Distribution in Grand Coulee Dam, Spillway Section, Effects of Bucket Included. By Edwin Rose, Associate Engineer, and Gordon F. Burk, Assistant Engineer (price $4.50). No. 620. Notes on Hydrodynamics, Vol. I. By C. P. Vetter, 1941. (Price $1.75.) No. 621. Notes on Hydrodynamics, Vol II. By C. P. Vetter, 1941. (Price $2.) No. 622. Horizontal Construction Joints. By R. F. Blanks and L. H. Tuthill, 1941. (Price $5.25.) No. 623. Mechanics of the Hydraulic Jump. By L. G. Puls, 10–1–41. (Price $3.75).

NOTES FOR CONTRACTORS

By **PERCY I. TAYLOR,** ***Assistant Chief, Engineering Division***

Specification No.	Project	Bid opening	Work or material	Low bidder		Bid	Terms	Contract awarded
				Name	Address			
D-1019	Deschutes, Oreg.	*1941* Dec. 29	Tunnels Nos. 1 and 2, North Unit Main Canal.	Kern and Kibbe	Portland, Oreg.	[1] $374,007.50		Feb. 25
1022	Columbia Basin, Wash.	*1942* Jan. 28	Control and distribution equipment for units L-4 to L-9, inclusive. Grand Coulee power plant.	General Electric Co.	Denver, Colo.	[1] 186,437.31	F. o. b. Odair, Wash.	Feb. 21
				Allis-Chalmers Manufacturing Co.	do	[2] 47,328.00	do	Do.
1023	Parker Dam Power, Ariz.-Calif.	Jan. 22	Power transformers, switching equipment, lightning arresters, voltage regulator and ground-fault neutralizer for Phoenix, Coolidge, and Tucson substations.	General Electric Co.	do	[3] 308,190.00	F. o. b. Phoenix, Coolidge, and Tucson.	Feb. 16
				Kelman Electric Manufacturing Co.	Los Angeles, Calif.	[4] 27,400.00	F. o. b. Phoenix, Ariz.	Do.
				Electric Power Equipment Corporation.	Philadelphia, Pa.	[5] 14,440.00	do	Do.
1597-D	Columbia Basin, Wash.	*1941* Dec. 29	Furnishing and installing structural-glass wainscots, partitions, strips and sills; travertine and appurtenant accessories; granite and appurtenant accessories for exterior front elevations of elevator towers and lobby drinking fountain.	W. P. Fuller & Co.	Spokane, Wash.	[6] 12,747.50	F. o. b. Ford City, Pa., and New Hartford, Conn.	Feb. 5
				Sunderland Brothers	Omaha, Nebr.	[7] 8,980.00	F. o. b. Odair, Wash.	Feb. 11
				Hilgartner Marble & Granite Co.	Los Angeles, Calif.	[2] 8,957.00	do	Do.
1605-D	Central Valley, Calif.	*1942* Feb. 11	One 17-ton cap, motor-operated overhead trolley.	Cyclops Iron Works	San Francisco, Calif.	9,100.00	Discount ⅛ percent	Feb. 19
1606-D	Columbia Basin, Wash.	Feb. 13	Carrier-current telephone terminal equipment.	Westinghouse Electric & Manufacturing Co.	Denver, Colo.	8,435.00	F. o. b. Almira, Wash.	Feb. 18
1608-D	do	Feb. 18	Structural steel for roof line-take-off structures and lightning-arrester supports for units L-4 to L-9, inclusive Grand Coulee power plant.	Creamer & Dunlap	Tulsa, Okla.	15,223.50	F. o. b. Odair, Wash.	Feb. 28
1609-D	Parker Dam Power, Ariz.-Calif.	Feb. 19	5 steel-sash windows of the fixed-sash type and one combination steel-sash window and louver assembly for Parker power plant.	Builders Service Bureau, Inc.	Denver, Colo.	4,705.00	Discount ½ percent; f. o. b. Youngstown and Marietta, Ohio; La Porte, Ind.; Ford City, Pa.; Chicago, Ill.; Denver, Colo.	Feb. 24
38,273-A	Columbia Basin, Wash.	Jan. 22	30,000 barrels of modified portland cement in bulk.	Lehigh Portland Cement Co.	Spokane, Wash.	49,500.00	F. o. b. Metaline Falls, Wash.; discount 10 cents per barrel.	Feb. 6
22,540-A	Boise-Anderson Ranch, Idaho.	Feb. 9	60,000 barrels of modified portland cement in paper sacks.	Idaho Portland Cement Co.	Inkom, Idaho	156,000.00	F. o. b. Inkom; discount 10 cents per barrel.	Feb. 21
27,795-A-1	Provo River, Utah	Jan. 30	8,000 barrels of standard portland cement in paper sacks.	Portland Cement Co. of Utah.	Salt Lake City, Utah.	17,600.00	F. o. b. Heber, Utah; discount 10 cents per barrel.	Feb. 13
48,924-A	Central Valley, Calif.	Jan. 26	5,000 barrels of standard portland cement in paper sacks.	Yosemite Portland Cement Corporation.	San Francisco, Calif.	10,875.00	F. o. b. Friant, Calif.	Feb. 11
B-33,075-A	do	Feb. 6	Steel reinforcement bars (2,510,000 pounds).	Carnegie-Illinois Steel Corporation.	Denver, Colo.	82,615.00	F. o. b. Coram, Calif.; discount ½ percent on b. p. v.	Feb. 2
17,070-A	Mancos, Colo., and Eden, Wyo.	Feb. 12	Two 75-horse power Diesel-engine-powered crawler tractors.	International Harvester Co.	do	[8] 7,115.84	F. o. b. Mancos, Colo.	Feb. 2
						[9] 6,393.54	F. o. b. Chicago, Ill.	Do.
D-38,314-A	Columbia Basin, Wash.	do	90,000 barrels of modified portland cement in bulk.	Superior Portland Cement, Inc.	Seattle, Wash.	143,100.00	F. o. b. Concrete, Wash.; discount 10 cents per barrel.	Feb. 2
1610-D	All-American Canal, Calif.	Feb. 19	3 motor-driven, vertical-shaft, pumping units complete with motor-control equipment.	Food Machinery Corporation, Peerles Pump Division.	Los Angeles, Calif.	2,916.00	F. o. b. Calexico, Calif.	Feb. 2
1612-D	Central Valley, Calif.	Feb. 20	Lifting beam, drawbridges, guides and accessory metalwork for hoist shaft in block 38, Shasta Dam.	Caird Engineering Works	Helena, Mont.	3,434.00		Mar.

[1] Schedules 1 and 2. [2] Schedule 3. [3] Schedules 1, 2, 11, and 14. [4] Schedule 4. [5] Schedule 7. [6] Schedule 1. [7] Schedule 2. [8] Item 1. [9] Item 2.

448847 U. S. GOVERNMENT PRINTING OFFICE: 1942

A 16-inch concrete core drilled out of Shasta Dam for laboratory test. *Below:* What happens to it in the Reclamation laboratory at Denver, Colo., where the core is placed under the tremendous pressure of the laboratory's 2,000-ton compression machine and —(1) sensitive dials show mounting internal stresses until (2) the core shatters explosively and (3) the pieces are inspected

HOW STRONG IS A DAM?

JUST HOW VULNERABLE is a dam? Would a direct hit by an enemy bomb cause any appreciable damage?

The minute inspection a beaver gives each branch and twig before putting it in place in his dam is multiplied a thousandfold by today's engineers in testing the concrete of a huge structure such as Shasta Dam, now being constructed on the Sacramento River, Calif., by the Bureau of Reclamation.

Field standards are maintained by testing aggregates and cylinders of concrete at the site. Aggregates are tested for permeability, specific gravity, chemical composition, size, and surface areas. Test cylinders are examined for specific density, permeability, compressive strength, elasticity, and contortion.

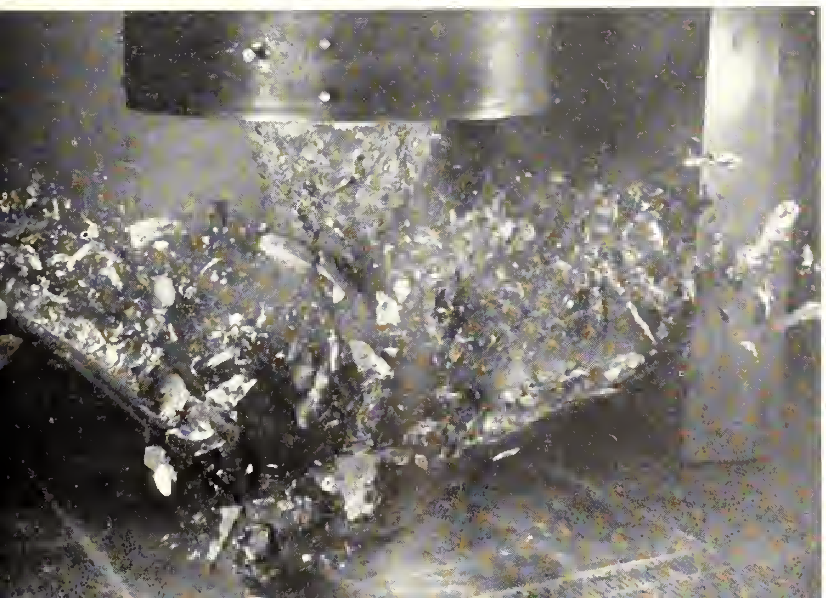
Samples hardened under various conditions of humidity and temperature and for different time intervals of 7 days to as much as 6 months are tested for an indication of reactions to be expected in the completed structure.

The most decisive test of all is the final test for strength which is made on a sample core extracted after the concrete has been placed in the dam and has hardened.

Calyx drills are used to take the sample cores from the mass of the dam. Like a giant apple-corer the enormous drill slices into the concrete, extracting a cylinder 16 inches in diameter. These samples are shipped to the Reclamation laboratory at Denver, Colo.

Upon arrival the ends of the sample core are shaved to insure perfect contact when set on end in the 2,000-ton compression machine. After careful checking and measuring the core is placed in the exact center of the testing shaft, and the engineer slowly and steadily applies pressure. Sensitive dial gages and other delicate measuring apparatus show the movement of the sample under heavy loads. The pressure exerted by the machine is gradually increased until the destruction point of the sample is reached—the point at which the entire core disintegrates.

In the tests made of the concrete at Shasta Dam, cores were found capable of withstanding a thousand tons before giving way—a pressure equivalent to that at the base of a column of water more than 4 miles high—sufficient force to set in motion a 500-car freight train.



ADMINISTRATIVE ORGANIZATION OF THE BUREAU OF RECLAMATION

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Operation and Maintenance Division, 910 U. S. National Bank Building, Denver, Colo.

John S. Moore, General Supervisor; Dean S. Stuver, Assistant General Supervisor; L. H. Mitchell, Irrigation Advisor; H. H. Johnson, Field Supervisor (headquarters at Great Falls, Mont.); T. W. Parry, Field Supervisor

Projects under construction or operated in whole or in part by the Bureau of Reclamation

Project	Office	Official in charge		Chief Clerk	District counsel	
		Name	Title		Name	Address
All-American Canal	Yuma, Ariz.	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Altus	Altus, Okla.	Russell S. Lieurance	Construction engineer	Frank E. Gawn	Spencer L. Baird	Amarillo, Tex.
Belle Fourche	Newell, S. Dak.	F. C. Youngblutt	Superintendent		W. J. Burke	Billings, Mont.
Boise	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Anderson Ranch Reservoir	Mountain Home, Idaho	John A. Beemer	Construction engineer		B. E. Stoutemyer	Portland, Oreg.
Boulder Dam and power plant	Boulder City, Nev.	Ernest A. Moritz	Director of power	Gail H. Baird	R. J. Coffey	Los Angeles, Calif.
Buffalo Rapids	Glendive, Mont.	Paul A. Jones	Construction engineer	Edwin M. Bean	W. J. Burke	Billings, Mont.
Buford-Trenton	Williston, N. Dak.	Parley R. Neeley	Resident engineer	Robert L. Newman	W. J. Burke	Billings, Mont.
Carlsbad	Carlsbad, N. Mex.	L. E. Foster	Superintendent	E. W. Shepard	Spencer L. Baird	Amarillo, Tex.
Central Valley	Sacramento, Calif.	R. S. Calland	District engineer	E. R. Mills	R. J. Coffey	Los Angeles, Calif.
Kennett division	Redding, Calif.	Ralph Lowry	Construction engineer	F. W. Gilbert	R. J. Coffey	Los Angeles, Calif.
Friant division	Friant, Calif.	R. B. Williams	Construction engineer	Geo. H. Witte	R. J. Coffey	Los Angeles, Calif.
Delta division	Antioch, Calif.	Oscar G. Boden	Construction engineer	F. D. Helm	R. J. Coffey	Los Angeles, Calif.
Colorado-Big Thompson	Estes Park, Colo.	Cleves H. Howell	Project engineer	C. M. Voyen	J. R. Alexander	Salt Lake City, Utah.
Colorado River	Austin, Tex.	Charles P. Seger	Acting construction engineer	William F. Sha	Spencer L. Baird	Amarillo, Tex.
Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Supervising engineer	C. B. Funk	B. E. Stoutemyer	Portland, Oreg.
Davis Dam	Kingman, Ariz.	Murray J. Miller	Engineer		R. J. Coffey	Los Angeles Calif.
Deschutes	Bend, Oreg.	Clyde H. Spencer	Construction engineer	Noble O. Anderson	B. E. Stoutemyer	Portland, Oreg.
Eden	Rock Springs, Wyo.	Thomas R. Smith	Construction engineer	Emanuel V. Hillius	J. R. Alexander	Salt Lake City, Utah.
Gila	Yuma, Ariz.	Leo J. Foster	Construction engineer	J. C. Thrailkill	R. J. Coffey	Los Angeles, Calif.
Grand Valley	Grand Junction, Colo.	W. J. Chiesman	Superintendent	Emil T. Ficenec	J. R. Alexander	Salt Lake City, Utah.
Humboldt	Reno, Nev.	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Kendrick	Casper, Wyo.	Irvin J. Matthews	Construction engineer	George W. Lyle	W. J. Burke	Billings, Mont.
Klamath	Klamath Falls, Oreg.	B. E. Hayden	Superintendent	W. I. Tingley	B. E. Stoutemyer	Portland, Oreg.
Mancos	Mancos, Colo.	Albert W. Bainbridge	Resident engineer	Harry L. Duty	J. R. Alexander	Salt Lake City, Utah.
Mann Creek	Weiser, Idaho	Louis B. Ackerman	Resident engineer	Ralph H. Geibel	B. E. Stoutemyer	Portland, Oreg.
Milk River	Malta, Mont.	Harold W. Genger	Superintendent	E. E. Chabot	W. J. Burke	Billings, Mont.
Minidoka	Burley, Idaho	Stanley R. Marean	Superintendent	G. C. Patterson	B. E. Stoutemyer	Portland, Oreg.
Mirage Flats	Hemingford, Nebr.	Denton J. Paul	Construction engineer		W. J. Burke	Billings, Mont.
Moon Lake	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Newton	Logan, Utah	I. Donald Jerman	Resident engineer	Hugh E. McKee	J. R. Alexander	Salt Lake City, Utah.
North Platte	Guernsey, Wyo.	C. F. Gleason	Superintendent of power	A. T. Stimpfig	W. J. Burke	Billings, Mont.
Ogden River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Orland	Orland, Calif.	D. L. Carmody	Superintendent	W. D. Funk	R. J. Coffey	Los Angeles, Calif.
Owyhee	Boise, Idaho	R. J. Newell	Construction engineer	Robert B. Smith	B. E. Stoutemyer	Portland, Oreg.
Parker Dam power	Parker Dam, Calif.	Samuel A. McWilliams	Construction engineer	George B. Snow	R. J. Coffey	Los Angeles, Calif.
Pine River	Durango, Colo.	Charles A. Burns	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Provo River	Provo, Utah	E. O. Larson	Construction engineer	Francis J. Farrell	J. R. Alexander	Salt Lake City, Utah.
Rapid Valley	Rapid City, S. Dak.	Horace V. Hubbell	Construction engineer	Joseph P. Siebeneicher	W. J. Burke	Billings, Mont.
Rio Grande	El Paso, Tex.	L. R. Fiock	Superintendent	H. H. Berryhill	Spencer L. Baird	Amarillo, Tex.
Riverton	Riverton, Wyo.	H. D. Comstock	Superintendent	C. B. Wentzel	W. J. Burke	Billings, Mont.
San Luis Valley	Monte Vista, Colo.	H. F. Bahmeier	Construction engineer		J. R. Alexander	Salt Lake City, Utah.
Shoshone	Powell, Wyo.	L. J. Windle	Superintendent		W. J. Burke	Billings, Mont.
Heart Mountain division	Cody, Wyo.	Walter F. Kemp	Construction engineer	John H. McCluer	W. J. Burke	Billings, Mont.
Sun River	Fairfield, Mont.	A. W. Walker	Superintendent		W. J. Burke	Billings, Mont.
Truckee River storage	Reno, Nev.	Floyd M. Spencer	Acting construction engineer		J. R. Alexander	Salt Lake City, Utah.
Tucumcari	Tucumcari, N. Mex.	Harold W. Mutch	Resident engineer	Charles L. Harris	Spencer L. Baird	Amarillo, Tex.
Umatilla (McKay Dam)	Pendleton, Oreg.	C. L. Tice	Reservoir superintendent		B. E. Stoutemyer	Portland, Oreg.
Uncompahgre: Repairs to canals	Montrose, Colo.	Herman R. Elliott	Acting construction engineer	Ewalt P. Anderson	J. R. Alexander	Salt Lake City, Utah.
Vale	Vale, Oreg.	C. C. Ketchum	Superintendent		B. E. Stoutemyer	Portland, Oreg.
Yakima	Yakima, Wash.	David E. Ball	Superintendent	Alex. S. Harker	B. E. Stoutemyer	Portland, Oreg.
Roza division	Yakima, Wash.	Charles E. Crownover	Construction engineer	Geo. A. Knapp	B. E. Stoutemyer	Portland, Oreg.
Yuma	Yuma, Ariz.	C. B. Elliott	Superintendent	Jacob T. Davenport	R. J. Coffey	Los Angeles, Calif.

Projects or divisions of projects of Bureau of Reclamation operated by water users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg.	A. Oliver	President	Marion Hewlett	Keating.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont.			Elsie W. Oliva	Hamilton.
Boise	Board of Control	Boise, Idaho	Wm. H. Tuller	Project manager	L. P. Jensen	Boise.
Boise	Black Canyon irrigation district	Notus, Idaho	Chas. W. Holmes	Superintendent	L. M. Watson	Notus.
Burnt River	Burnt River irrigation district	Huntington, Oreg.	Edward Sullivan	President	Harold H. Hursh	Huntington.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.		Superintendent	Ralph P. Scheffer	Huson.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo.	S. F. Newman	Superintendent	A. W. Lanning	Austin.
Grand Valley Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.		Superintendent	C. J. McCormick	Grand Jctn.
Humboldt	Pershing County water conservation district	Lovelock, Nev.	Roy F. Meffley	Superintendent	C. H. Jones	Lovelock.
Huntley	Huntley Project irrigation district	Ballantine, Mont.	S. A. Balcher	Manager	H. S. Elliott	Ballantine.
Hyrum	South Cache W. U. A.	Logan, Utah	H. Smith Richards	Superintendent	Harry C. Parker	Logan
Klamath, Langell Valley	Langell Valley irrigation district	Bonanza, Oreg.	Chas. A. Revell	Manager	Chas. A. Revell	Bonanza.
Klamath, Horsefly	Horsefly irrigation district	Bonanza, Oreg.	Benson Dixon	President	Dorothy Eyers	Bonanza.
Lower Yellowstone	Board of Control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney.
Milk River: Chinook division	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	R. H. Clarkson	Chinook.
	Fort Belknap irrigation district	Chinook, Mont.	H. B. Bonebright	President	L. V. Bogy	Chinook.
	Zurich irrigation district	Chinook, Mont.	C. A. Watkins	President	H. M. Montgomery	Chinook.
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	President	R. L. Barton	Harlem
	Paradise Valley irrigation district	Zurich, Mont.	C. J. Wurth	President	J. F. Sharples	Zurich.
Minidoka: Gravity	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Assistant manager	Frank A. Ballard	Rupert.
Pumping	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	Manager	Frank O. Redfield	Burley.
Gooding	Amer. Falls Reserv. Dist. No. 2	Gooding, Idaho	S. T. Baer	Manager	Ida M. Johnson	Gooding.
Moon Lake	Moon Lake W. U. A.	Roosevelt, Utah	H. J. Allred	President	Louie Galloway	Roosevelt.
Newlands	Truckee-Carson irrigation district	Fallon, Nev.	W. H. Wallace	Manager	H. W. Emergy	Fallon.
North Platte: Interstate division	Pathfinder irrigation district	Mitchell, Nebr.	G. H. Storm	Manager	Flora K. Schroeder	Mitchell.
Fort Laramie division	Gering-Fort Laramie irrigation district	Gering, Nebr.	W. O. Fleenor	Superintendent	C. G. Klingman	Gering.
Fort Laramie division	Goshen irrigation district	Torrington, Wyo.	Floyd M. Roush	Superintendent	Mary E. Harrach	Torrington.
Northport division	Northport irrigation district	Northport, Nebr.	Mark Iddings	Manager	Mabel J. Thompson	Bridgeport.
Ogden River	Ogden River W. U. A.	Ogden, Utah	David A. Scott	Superintendent	Wm. P. Stephens	Ogden.
Okanogan	Okanogan irrigation district	Okanogan, Wash.	Nelson D. Thorp	Manager	Nelson D. Thorp	Okanogan.
Salt River	Salt River Valley W. U. A.	Phoenix, Ariz.	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix.
Sanpete: Ephraim division	Ephraim Irrigation Co.	Ephraim, Utah	Andrew Hansen	President	John K. Olsen	Ephraim.
Spring City division	Horseshoe Irrigation Co.	Spring City, Utah	Vivian Larson	President	James W. Blain	Spring City.
Shoshone: Garland division	Shoshone irrigation district	Powell, Wyo.	Paul Nelson	Irrigation superintendent	Harry Barrows	Powell.
Frannie division	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	Manager		Deaver.
Stanfield	Stanfield irrigation district	Stanfield, Oreg.	Leo F. Clark	Superintendent	F. A. Baker	Stanfield.
Strawberry Valley	Strawberry Water Users' Assn.	Payson, Utah	S. W. Grotegut	President	E. G. Breeze	Payson.
Sun River: Fort Shaw division	Fort Shaw irrigation district	Fort Shaw, Mont.	A. R. Hanson			
Greenfields division	Greenfields irrigation district	Fairfield, Mont.	A. W. Walker	Manager	H. P. Wangen	Fairfield.
Umatilla: East division	Hermiston irrigation district	Hermiston, Oreg.	E. D. Martin	Manager	Enos D. Martin	Hermiston.
West division	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	Manager	A. C. Houghton	Irrigon.
Westland	Westland irrigation district	Hermiston, Oreg.	F. M. Caverhill	Manager	F. M. Caverhill	Hermiston
Uncompahgre	Uncompahgre Valley W. U. A.	Montrose, Colo.	Jesse R. Thompson	Manager	H. D. Galloway	Montrose
Upper Snake River storage	Fremont-Madison irrigation district	St. Anthony, Idaho	H. G. Fuller	President	John T. White	St. Anthony.
Weber River	Weber River W. U. A.	Ogden, Utah	D. D. Harris	Manager	D. D. Harris	Ogden.
Yakima, Kittitas division	Kittitas reclamation district	Ellensburg, Wash.	G. G. Hughes	Manager	G. L. Sterling	Ellensburg.

MAY 1946

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Here's Your Farm

By Representative John R. Murdock

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MY NEW JOB

By Secretary J. A. Krug

★

RECLAMATION *Faces the Peace*

By Commissioner Michael W. Straus

THE *Reclamation* ERA

Reclamation ERA

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Contents

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Publication of ERA Resumed

This is the first issue of the* Reclamation Era *to appear since April 1942, when publication was suspended as a wartime measure. The editors hope to maintain the high standards set by their predecessors and invite your comments. A new "Letters to the Editor" column has been added for this purpose.

Former subscribers will receive the issues due them. In spite of increased costs, the former subscription rate still prevails, $1 a year for 12 issues. If you are not a subscriber, you may fill in and mail the blank on page 110 to us. Please notify the* Reclamation Era *of any change in address.

MY NEW JOB

By J. A. KRUG, *Secretary of the Interior*

The discovery almost every day of new uses for the materials of which the world is made—our natural resources—makes the job of Secretary of the Interior today quite different from the job faced by any of my predecessors when they assumed office. Good administration of the public domain has become more crucial than ever before.

Not only are our stores of iron, copper, zinc, lead and petroleum diminishing, but as population increases and techniques of using all of these substances increase, the quantities we shall require continue to grow. The provision of low-cost water for irrigation, and the broad dissemination of low-cost electrical energy, combines to focus public interest on the wise development of our water resources.

Wise Resource Use Is Vital

From the standpoint of international security, too, the possession of ample supplies of raw materials and power resources has become vital. To cite one item alone—uranium ore, the stuff from which atomic energy is now derived—presents an extremely important problem in administration. Upon its wise use our economic and political history may depend. Also, from a military standpoint, development of all the electric energy that can be derived from all of our rivers may be a deciding factor, for the ability to hold our own when force is needed is related directly to the energy resources that can be mobilized quickly. This is an angle sometimes overlooked when problems of public power administration are considered.

The concept of coordinated resource development for great river basins, first demonstrated by the Tennessee Valley Authority, also holds great promise. The Bureau of Reclamation, with the cooperation of other Interior agencies, is making studies for such development in all of the important river basins of the West, and these will be submitted to the Congress soon. A plan for the Missouri River Basin already has been adopted by the Congress, and its first engineering phases are being executed by four major Federal agencies coordinated through the Federal Interagency River Basin Committee.

It is also becoming clear that a program for development of our resources must be tied closely to a public works program, which can be used as an economic balance wheel, to be thrown into high gear when unemployment is threatened, although a steady peacetime development has become part of our long-term program. It is also clear that more irrigated farms can lead to a more stable agriculture.

THE NEW SECRETARY—*J. A. Krug, power expert and chairman of the War Production Board, who took office as Secretary of the Interior on March 18, 1946, succeeding Harold L. Ickes. Long known for his advocacy of natural resource development, the new Secretary, as chief power engineer of the Tennessee Valley Authority, negotiated the sale by which TVA acquired the Tennessee properties of Commonwealth and Southern. Under the Office of Production Management and its successor, the War Production Board, Mr. Krug geared the Nation's utilities for war. In 1943 he became vice chairman of WPB in charge of the allocation of vital war materials. Mr. Krug left WPB to accept a commission as a lieutenant commander in the Navy. His naval duty was ended by President Roosevelt who called him to the WPB chairmanship. After leaving Government service, he was a consultant to industrial concerns. Mr. Krug is a native of Madison, Wis. He earned his A. B. and M. A. degrees at the University of Wisconsin where he was center on the football team. He worked his way through college as a filling station attendant.*

The stake which the people as a whole have in natural resource development has led to the development of a body of laws to protect land owners and promote expansion along sound lines. The anti-speculation provisions and the acreage limitation clauses in the Reclamation law are examples of this.

From the time when irrigation was first developed importantly in the West, there have been soundly conceived and administered private projects. The tendency, however, was to overdevelop—to bring more land under cultivation than the available supply of water would warrant. This was due partly to a lack of knowledge of the extent of our water resources, partly to the unscrupulous greed of land speculators, and partly to the natural tendency of farmers to expand irrigation operations during the cycles of heaviest rainfall and during dry cycles to discover they had overreached.

There are currently many examples of rich farming areas, which have been intensively overdeveloped. Underground reservoirs have been drawn on so heavily by pumping that the entire agriculture of these areas is threatened.

Rich Acreages Undeveloped

Preservation of the once-rich grazing lands of the West also is an area of administration where public interest has brought the Department of the Interior to ameliorate abuses in an effort to restore, at least partially, a resource which once produced vast quantities of low-cost beef for Americans.

Today, the Department of the Interior is faced with a new problem in resource conservation. The Tennessee Valley Authority and the Bureau of Reclamation have demonstrated what can be done to improve economic conditions by the intelligent disposition of electrical energy produced at public dams. The TVA experiment has kindled popular imagination. People in other parts of the country desire to avail themselves of similar benefits which might be developed from the water resources of their regions.

At the same time, other people fear that if the Federal Government assumes the initiative in the development of valley authorities, that State and local governments will become subordinate to them. While good administration of the TVA has prevented this from happening in the Tennessee Valley, some fear that the valley authority corporate form of administration is basically bad. This is a problem to which I will give much study before I declare a policy.

Water Control Primary

But I can say that I am in favor of the development of public power where it can be provided economically in coordination with the basic water control functions of the Federal Government. Low-cost power means the stimulation of small business, an increase in domestic conveniences, and an increase in military strength.

The relationship of an expanded public power program to the private utility industry involves many difficult problems, which will not instantly be resolved. Public agencies can often develop the water power of an area to its maximum through multipurpose projects which include irrigation, navigation, flood control, municipal water supply, and other purposes. The sale of power can be applied to help carry the cost of building irrigation and other water control projects.

The most economical development of water resources often involves operations which extend into several States, and only a Government agency is in a position to resolve the conflicts which arise from enterprises of this scope. It is not impossible, moreover, that in the future it will be desirable for the Government to construct great power grids which will distribute electrical energy over wide areas.

No Insoluble Conflicts Seen

However great the development of public power may be, it probably will not keep pace with the increasing use of electricity. Hence, the field for private utilities also is likely to expand. If expansion of both private and public power production is wisely administered, there need be no insoluble conflicts between them. Overreaching or too rapid expansion by either, or employment of unsound methods, would weaken the position of either.

We are discovering that Government must exercise leadership in many fields of economic activity, if the Nation is to avoid excessive peaks of inflation and depression. Coordinated valley resource development, price control and maintenance of agricultural parity prices, construction of the vast industrial plant which produced munitions of war—all represent fields in which Government has had to assist private industry in the interest of all of the people.

The more you think about the matter, the more it becomes clear that the further development of our remaining natural resources of the United States, including the electrical energy which can be produced from its rivers, is one of the fields in which Government enterprise has come to stay.

In administering my responsibilities in this respect, I shall not overlook the private interests affected. I recognize that our system of capitalistic enterprise depends upon healthy private business, and I have no desire to replace private wit[h Govern]ment-owned enterprise.

I intend to take up each prob[lem sepa]rately as it arises, and in each i[nstance] consider long-term consequences [as well as] the immediate results. But the [pat]tern of how the public domain is [ad]ministered must rest with the [Congress. I] can only make recommendatio[ns to the] Congress when a new pattern o[f adminis]tration is being evolved.

VISITORS' RECORDS TOPPLE AT BOULDER DAM

Nearly thirty-four thousand more people crossed Boulder Dam during the first three months of 1946 than in any other first quarter since records were begun in 1938. Nearly three thousand more persons were conducted on the guided tour through the dam and power plant than in any like period since guide service facilities were established in 1937. March 1946, with a total of 24,008 taking the conducted tour, exceeded every other month since the dam was reopened to visitors on V–J Day last September.

With 163,991 persons crossing the dam in the first 3 months of 1946 as compared to the 1941 total of 129,850—the previous record—and 58,804 taking the conducted tour as compared to 55,936 in the first 3 months of 1941, it appears that all previous yearly records will fall.

Following are given first quarter totals for past years as compiled by Bureau of Reclamation and National Park Service statisticians: Number of persons crossing Boulder Dam (first quarter totals).

1938—80,761	*1940*—105,457	*1945*—163,991
1939—79,999	*1941*—129,850	

Number of persons taking conducted tour of Boulder Dam (first quarter totals).

1938—41,543	*1940*—52,216	*1946*—58,804
1939—42,137	*1941*—55,936	

One Reclamation official's rea[ction: If] they come in such numbers now, [what will it] be this summer when schools are [out and] people begin to take vacations aga[in?]

It won't be long until that quest[ion is] answered.

Chinese Engineer Lauds Central Va[lley]

C. W. Wu, an engineer of the H[...] Commission, China, went over th[e] the Central Valley project in C[alifornia.] Engineer Wu said, "China looks t[o ...] as a model in developing the H[...] China's third largest stream, for [multiple-]purpose uses."

Engineer Wu is interested part[icularly in] the Bureau's program to stop [salt water] from intruding up the Sacrament[o and San] Joaquin Rivers into the Delta are[a.]

"The Central Valley project of [...] is very famous in China because [it is multi]ple-purpose, just like we want in [our coun]try," he said.

The California Taxpayer's A[ssociation] estimates the State's population [...]000, a gain of 2,342,000 or 34 pe[rcent since] 1940.

VETERANS—
Here's Your Farm

By the Honorable JOHN R. MURDOCK, of Arizona
Chairman, Irrigation and Reclamation Committee, House of Representatives

This time the Nation is not forgetting the men who fought to keep it free. The veteran, his war job done, is upper-most in our minds. His welfare will remain our first concern until we have enabled him to gain his place in civilian endeavor without handicap caused by his service.

There are many Members of Congress who believe that, of all the programs being pushed because of their capacity to aid the veterans, Reclamation offers most—at least, in the long run. I count myself among that group.

It is not coincidental—and neither is it strange—that the Reclamation projects authorized in pre-war days by the Congress should become a major hope for postwar days. Those projects were authorized to create new farms, to widen dangerously narrow farming opportunities, to turn wasted resources into productive power.

Almost one and a half billion dollars in projects received this congressional approval. The Bureau of Reclamation was able to continue essential project planning during the war, to be ready for large scale construction when money became available.

The Congress is making that money available. For the current fiscal year the Reclamation total is approximately $160,-000,000, more than the Bureau has ever had in one year. The need for those new farms, greater farming opportunities, and additional productive power will be more urgent than ever in these postwar years. I believe that the Congress will gladly appropriate sufficient funds to meet this need.

Nation and Veteran to Benefit

This program, conceived in the old peace and now being executed in the new, aids the veteran because preference for new farming opportunities will be his. It aids the Nation because it adds new farm and industrial capacity to produce. The veteran and the Nation are inseparable. What helps the one helps the other. That is why Congressmen who believe as I do say that of all the veteran-aid programs, none offers more than Reclamation.

Just the other day an enthusiastic but misguided Reclamationist said to me: "What can we do for the veteran? A million men who were in the armed forces want to locate on the farm. For every public land farm we have to offer, there will be hundreds of applicants. Our program, at best, is a small one."

That fellow should realize that few programs promise greater impact upon the veteran's future than one providing—during the next 5 years—irrigation service to 42,000 farms which now have none and giving adequate water to 28,000 farms which now have a supply too scanty for profitable production. And this is in addition to the 4,500 homestead farms that will be created and the great water resources to be brought into man's use for the first time.

Then, on the other hand, there is the man who deprecates Reclamation because "we don't need new farms. We already produce too much."

Nation's Agriculture to Profit

There are production figures to refute this man's view. There are almost daily news accounts telling of the Nation's crying need for food, to meet obligations abroad and shortages at home. To answer this man most simply and most definitely, however, I have a saying which I should like to think is axiomatic:

"An underdeveloped West and a fully prosperous Nation do not—and never can—go hand in hand."

Just what does the Reclamation program offer the veteran? Projects authorized by the Congress can, by 1951, accomplish the following for the Nation's agriculture:

Create 4,581 new homestead farms.
Provide initial irrigation water to 42,208 private land farms.
Give supplemental irrigation water to 28,317 private land farms.

These figures are conservative. They do not include the 100,000 new farms in potential projects the Bureau of Reclamation

HERE ARE THE LANDS—*H. H. Johnson, Bureau of Reclamation's Region VI Operation and Maintenance superintendent, and L. J. Windle, Shoshone project superintendent, inspect a part of the Heart Mountain Division of the Shoshone project that will be opened for settlement this summer. They are looking towards the entrance of Shoshone Canyon.*

has offered the Congress for future authorization. Neither do they include 1,200 homestead farms which may be added to the Minidoka project in Idaho by adjustments in water use.

The privately-owned lands being irrigated will not necessarily be available for purchase or new settlement. Some undoubtedly will be farmed by their present owners. Because the Reclamation laws limit the delivery of water to 160 acres of irrigable land in one ownership, excess lands will be offered for sale in most of the project areas. Sales prices must be satisfactory to the Secretary of the Interior in order for water to be delivered to the land. Purchase negotiations are conducted between the owner and the would-be buyer.

The Bureau of Reclamation has begun a great land purchase program on the million-acre Columbia Basin project in the State of Washington. Lands will be resold to new settlers in units averaging perhaps 80 acres.

Veterans of World War II have at least a 90-day preference in homesteading on public land farms—for 90 days after the opening date established by public notice only veterans will be considered. The number of veterans seeking a public land farm obviously exceeds the number of such farms to be available. Under existing law veterans only have preferred rights to Reclamation farms on public lands opened to homestead entry. The creation of thousands of new farms through irrigation of privately owned lands, however, is certain to make farms easier to obtain by veterans, former war workers, and other civilians alike.

Much Depends on Congress

So, this Reclamation program has much to attract the farm-minded veteran. Yet, the fulfillment of all this promise for the years between 1946 and 1951 is dependent upon some very big ifs: if, for example, the Congress continues, in the fiscal years beginning this July 1, to appropriate funds sufficient for the large-scale work required; if the necessary materials can be obtained; if the hundreds of able technicians and professional men needed can be found for Reclamation employment. . . .

Actions taken by the Congress have much to do with making these ifs certainties. We Westerners intend that the entire Nation shall reap maximum benefits from the Reclamation projects. In the final analysis, however, the Reclamation program belongs as much to the East and South as to the West, for the jobs it creates (40,000 man-years of employment in the year ending this June 30 and 143,500 man-years estimated for the next year's fiscal program) recognize no State boundaries. The increased purchasing power resulting from Reclamation projects (by 1944 this had reached a cumulative total of almost one and a half billion dollars) also is no respector of State lines.

Many do not realize that the first fruits of the postwar Reclamation program are about to be enjoyed. Homesteading on irrigated lands is to be resumed immediately. Homestead lands on the Klamath (California-Oregon), Yakima (Washington), and Shoshone (Wyoming) projects are to be opened about August 1 and on the Minidoka project (Idaho) in the fall. Almost 300 veterans will obtain farms through these openings. There will be about 850 homestead farms involved in 1947's openings. More than 3,500 of the privately owned farms are to receive their first irrigation water during 1946 and 1947, probably creating farm purchase opportunities in each of the Reclamation States.

Local Boards Select Settlers

I am glad to know that the Bureau of Reclamation plans to rely upon local boards of examiners in settler selection. These boards, on which the water users will be represented, are to be appointed by the Commissioner of Reclamation, a separate board for each project on which there are public lands. Each board will set the minimum qualifications for homesteading on its project, subject to approval of the Secretary of the Interior.

Past minimum requirements have included $2,000 of usable capital assets, farming experience, high moral character, and industriousness. In addition to minimum financial needs, the settler must be prepared to pay the annual operation and maintenance charge that begins with the commencement of irrigation service, the living and farm expenses that will arise before he reaps a crop, and his share of the project construction obligation. This last, usually amortized over a period of 40 years, does not begin until after expiration of the development period allowed for the land to be brought into full production.

Irrigation farming is a highly specialized business. It requires work, and skill. It demands capital, as a rule more capital than the minimum needed to qualify as a homesteader. Those who are successful in obtaining Reclamation homesteads definitely will not be getting something for nothing.

Fortunately, the GI Bill of Rights assures each veteran of liberal financial aid. Those who have a reasonable chance of success will find it possible to use this aid in purchasing a Reclamation farm.

That veterans recognize this opportunity is beyond doubt. Thousands of inquiries already have come to Reclamation offices from prospective homesteaders. Even opportunities to lease irrigable public lands for short periods, without any hope of land security, are eagerly sought. This was shown by a recent lease bid opening on the Klamath project, where a 10-day preference was given veterans. It was the first such opportunity offered World War II veterans by the Reclamation Bureau. Far more than enough acceptable bids were received from veterans, although the openings were advertised only locally.

Reclamation Pays

As much as the Reclamation program offers the individual, I like to think that it offers the Nation more. It adds to our human resources at the same time that it makes use of our natural resources. It pays its own way. It is a public works program that emphasizes permanency rather than expediency.

We of the West who have seen Reclamation at work are happy that it has been chosen as one of the builders of the postwar world.

CLAMORING FOR KLAMATH—*Veterans of World War II, like their dads, like to farm. Opportunities to lease public lands, as well as to homestead on them, are widely sought. This was demonstrated on the Klamath project when veterans were invited to bid for short leases. Here, veterans anxiously await outcome as bids are opened for the leasing of Lower Klamath Lake lands on the Klamath project in Oregon.*

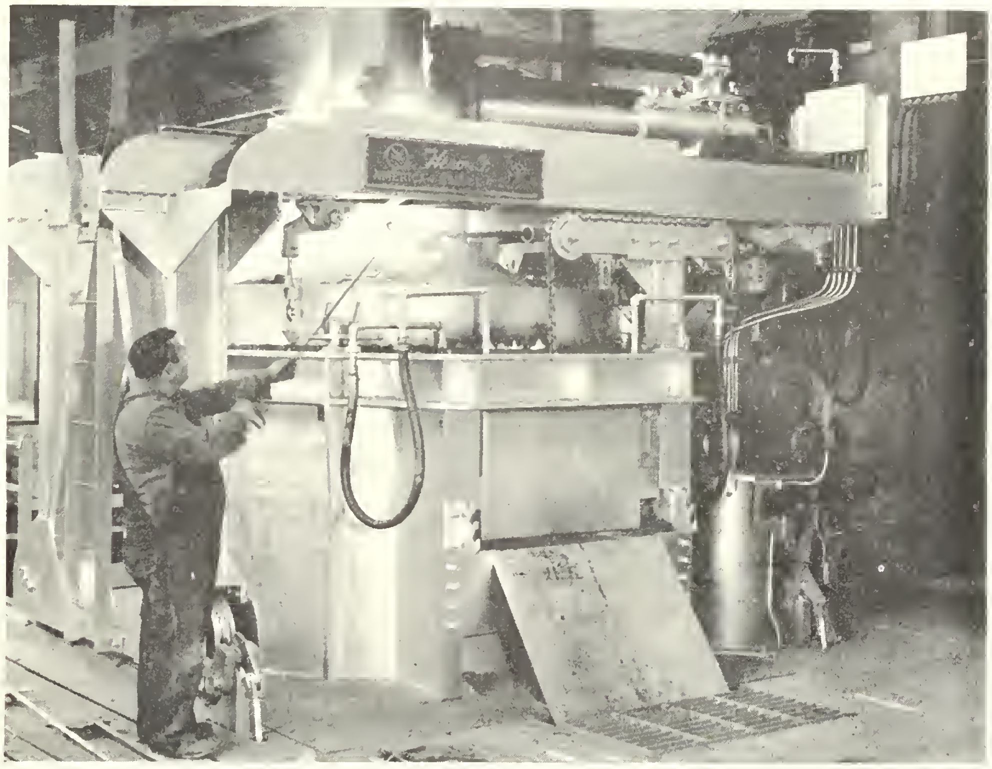
Making the Most of Minerals

Shasta Power Opens Up New Possibilities for Western Mining Operations

How to get the most out of mineral resources is the aim of the new Redding, Calif., electric steel pilot plant at Shasta Dam on the Sacramento River. This pilot plant, made possible by the availability of low-cost electric power from Shasta Dam, was put into operation in March 1946, opening up new possibilities for postwar industrial development in California and Oregon.

The Bureau of Reclamation participated in this enterprise by providing the facilities for delivering power over a direct line from the Shasta plant across the river to the pilot plant.

The pilot plant is one of several in which the Bureau of Mines is attempting to demonstrate the more effective utilization of the country's available mineral resources by the use of low-cost electric power. In the plant at Redding, Calif., steels will be made from the high-grade iron ores, manganese, and chromium minerals available in the area around Shasta Dam. Because these ores are located so far from Eastern markets, their potentialities never have been realized. Also the grade of these ores has made them of little use and the development of such ore deposits in California and Oregon has not gone forward. It is not practical to utilize these materials by the customary methods of smelting.



EXPERIMENTAL STEEL-MAKING—*Standard steels and new alloys from the iron, manganese, and chromium metals of California and Oregon may be possible as the result of experimental work in this electric arc furnace of the Heroult type just put into operation by the Bureau of Mines in the pilot plant at Shasta Dam, Redding, Calif., in cooperation with the Bureau of Reclamation.*

New Alloys for Industry

The Bureau of Mines, however, has developed suitable methods of producing the pure metals from these ores, and at Redding it is planned to combine these pure metals to produce standard steels as well as new alloys, and to demonstrate the use of these new alloys in western industry.

First the iron ores are converted to sponge iron in the pilot plant located at Laramie, Wyo., while the manganese and chromium ores are converted into electrolytic manganese and electrolytic chromium at the Boulder City, Nev., plant.

The metals are then sent to the Redding plant which, along with these other pilot plants operated by the Bureau of Mines, is pioneering in demonstrating new processes for utilizing the mineral resources of the west coast.

The new plant is completely equipped for the test-production of alloy steel ingots of sizes suitable for rolling and forging in west coast industrial plants. A direct arc furnace of the Heroult type has been installed.

One of the earliest furnaces of that name was used in a plant at a place named Heroult, situated on Pit River upstream from its junction with the McCloud River. A good quality pig iron was produced by that plant from iron ore and other materials mined in that region during the years 1907 to 1914. During World War I, ferromanganese, ferrosilicon, and probably some ferrochrome were produced. After that, the plant was abandoned and dismantled and the site of the old smelter and town of Heroult is now deeply covered by the waters of Shasta Lake, which will produce the electric power used by this furnace.

Of possible longtime significance to California, far beyond the development scope of the gold rush of the 1850's, the Shasta pilot plant holds out to California industry new prospects for postwar development and extension of the benefits of the power generated by the Central Valley project to an entire new field of productive endeavor.

Our Front Cover

A SAILOR RETURNS—***But Not to Dry Land. Spence Greaser, with a friend of his school days, Cora Mae Bass, walking through lush fields of alfalfa, made possible through the opening of the 75-mile Conchas Canal. When Spence left his hot semiarid New Mexico home at 17 to join the Navy, he didn't expect to find so many changes. Conchas Canal now brings a dependable irrigation water supply to the Bureau of Reclamation's Tucumcari, N. Mex., project. When completed, the project will turn 45,000 semiarid acres into productive lands.***

Pioneering in the Missouri Basin

By HAROLD I. SYLTEN*

The only new thing about Missouri Basin development is that now something is being done about it.

More than 42 years ago in Ogden, Utah, engineers of the Reclamation Bureau (then called the Reclamation Service) heard the first of many reports dealing with investigations of water resources within the Missouri River Basin. They were pioneers in a new field of Federal reclamation, and out of the reports which they heard came Missouri Basin Reclamation projects such as the Milk River in Montana, the Belle Fourche in South Dakota, the North Platte in Nebraska and Wyoming, the Shoshone in Wyoming, and others.

Stanley Vestal, well-known educator and writer, in his contribution to the Rivers of America Series, *The Missouri*, observed:

"There are rivers that exist in time—or in eternity. But the Missouri River quite manifestly exists in space. It is on its way. It moves magnificently over vast distances. It is forever going places. Not only that, it is forever doing things."

The Missouri River has been doing things for centuries. Unfortunately, it has shown but little selective ability. Uncontrolled and unharnessed, it has been constantly destructive and comparatively useless.

Pioneers in Missouri River Basin planning knew that a river with so forceful a personality had potentialities for behavior that could pay big dividends. The Bureau of Reclamation has been actively engaged for more than 40 years in transforming these latent resources into actual realities and on December 22, 1944, when the late President Roosevelt signed the Flood Control Act, a new era for the Missouri River Basin was inaugurated.

It was the end of a period of preparation for basinwide development and the beginning of a period of action. Today, basinwide planning for all the major river basins of the West is being carried forward by the Bureau along lines pioneered in the Missouri.

The unified plan of the Bureau of Reclamation and the Corps of Engineers, United States Army, thus authorized and approved, provides for the irrigation of 4,760,000 acres of new land now dry and for supplemental water supplies for 520,000 acres inadequately irrigated because of water shortages. This will be accomplished through the construction of reservoirs, pumping units and other works in the seven arid and semiarid States of the Missouri River Basin—Montana, Wyoming, North Dakota, South Dakota, Kansas, Nebraska and Colorado.

When engineers of the Reclamation Service held their first conference in 1903, they were aware of a stirring challenge. To capture the rushing flow of mountain streams, so that water would be diverted to arid lands, called for engineering skill and ingenuity. Their accepted task appealed to the imagination of many men who had shared in the job of providing for the irrigation of nearly 3,000,000 acres prior to the passage of the Reclamation Act in 1902.

How Basin Planning Developed

Realizing that, as the demand for irrigated land increased, many projects would be beyond the capacity of private enterprise, they recognized the need for an agency such as the Reclamation Service. And so through the years, as concepts of planning developed from the single-purpose to multiple-purpose projects and then to basin-wide development, the Bureau of Reclamation continued its work.

Today in the seven States of the Missouri River Basin alone, States west of the 97th meridian, there are 11 completed Bureau of Reclamation projects serving a population of more than 80,000 persons on 9,000 farms and in 65 towns and villages.

Construction at Hand

Section 9 of the Flood Control Act of 1944 authorized the construction of 29 units of the Missouri Basin project as the initial phase of the basin-wide developmental program. This program, being prosecuted with funds available under the regular appropriation and first deficiency appropriation for the fiscal year 1946, is directed toward starting construction on 11 units by July 1, 1946. These are the Canyon Ferry and Lower Marias units in Montana; Boysen, Owl Creek, Kortes, and Glendo in Wyoming; Heart River in North Dakota; Angostura in South Dakota; Kirwin in Kansas; Frenchman-Cambridge in Nebraska, and the initial phase of the Bostwick unit in Kansas and Nebraska. These units will provide for the irrigation of 216,990 acres of new land and will bring supplemental water to 31,195 acres. Hydro power plants producing more than 80,000 kilowatts of firm power and 10,000 kilowatt-hours of secondary power are included in the initial construction phase.

Because of its importance, the North Dakota division of the Missouri-Souris unit was included in the program for the first year's activities for further study and investigation. This unit proposes the irrigation of

*Acting Regional Information Officer, Region VI, Billings, Montana.

more than a million acres in northwestern North Dakota by diversion of water from the Missouri below Fort Peck.

The remaining 17 authorized units include Glasgow Bench Pumping, Hardin (including Yellowtail Dam), Montana division of the Missouri-Souris unit, South Bench, and Yellowstone Pumping units, Montana; Big Horn Pumping units, Paintrock, and Riverton and Shoshone project extensions, Wyoming; Knife River and Missouri River Pumping units (5), North Dakota; Grand River, Oahe (James River), and Rapid Valley, South Dakota; pumping units in the Republican River Basin west of Culbertson, Nebr.; Cedar Bluff, Kans., and North Republican (Wray, Colo.), Nebr.

The total acreage of land to be brought under irrigation by the authorized construction is 2,836,000, or 46 percent of the total of the approved plan. Supplemental water will be provided for 62,885 acres, or 9 percent of the area now irrigated that would be benefited by supplemental supplies.

Crops To Be Stabilized

A well-based agriculture depends upon an abundance of moisture available for crop production. In the Missouri River Basin west of the 97th meridian, there is seldom more than 20 inches of rainfall and in many areas its seasonable distribution is of a nature that makes farming a precarious industry. The irrigation developments contemplated in the Missouri River Basin plan will stabilize areas extending for hundreds of miles. Range land will be able to support a larger livestock population through assured feed supplies during the winter. Stockmen and farmers may plan adequate supplies of emergency feed and prevent forced livestock sales in years of drought.

Exclusive of the stabilization of the surrounding areas the measurable benefits from the irrigation and power developments, under the over-all approved plan, are extensive and far-reaching. It has been estimated that increased crop returns will total $130,000,000 annually. Fifty-three thousand additional farms will provide for an increase of 212,000 persons in rural areas. Bureau of Reclamation records show that for every person on an irrigated farm there are two persons in the adjacent urban area engaged principally in service industries. A prospective increase in population of 636,000 in the Missouri River Basin, from irrigation development alone, will have a marked effect not only on the economy of that region but on the Nation as a whole. The average assessed valuation per capita in the basin, exclusive of the more populous southeastern section, approximates $1,000. Increased valuation of more than $600,000,000 thus may be anticipated.

Billions of kilowatt-hours of low-priced power for farm, home, and industry, brought to all areas within the Basin, will stimulate industrial enterprise and improve rural and urban living standards.

Employment for Thousands

But the benefits will not be confined to the Missouri Basin alone. They will be Nation-wide. When construction begins it will provide employment for thousands. For every hour of work at a Reclamation unit site, approximately 1.6 hours of employment will be provided off the site.

NUMBER ONE JOB—*The Kortes Dam site on the North Platte River where the first spade will be turned to start the Bureau of Reclamation's new construction program for the development of the Missouri Basin.*

This distribution of labor carries with it comparable Nation-wide expenditures. Lumber, cement and steel will be required in the construction of dams and power plants. Hardware and electrical supplies and many other items will be needed. Beginning as raw materials, their transportation to factories for fabrication, their fabrication and return to the place needed, will require millions of man-hours in mines, factories and in transportation.

Nor do these extended benefits cease when construction is completed. Thousands of new homes will be built and furnished. Farm equipment will be needed. The additional purchasing power of thousands of people on irrigated farms, assured of a stabilized income, will be reflected in the factories of the West, Midwest, East, and South.

A new frontier is in the making, a frontier with as much potential promise as that which beckoned the first adventurers to the plains of the Dakotas and the mountains of Montana and Wyoming when the Missouri was the highway to the West.

When Capt. Meriwether Lewis ascended the Marias River in June 1805, to determine which stream was the main Missouri, and more thoroughly explored its winding course on his return, he could not have even remotely envisioned what the years would bring. For here on the Marias River the Bureau of Reclamation plans the construction of the Tiber Dam to provide water for the irrigation of 120,000 acres of new land. Viewed from the air its alternate strips of fallow land and growing wheat or stubble present a novel appearance. In a few years it will be dotted with hundreds of farm homes and irrigated fields and pastures. Diversified crops such as corn, potatoes, beets, and alfalfa will bring a stabilized income to an area long subject to the vagaries of a one-crop economy. Similar changes will come to scores of other areas throughout the length and width of the Missouri Basin—to communities whose residents have observed for many years what reclamation can do.

River with a Personality

Years ago a humorist said, "There is only one river with a personality, a sense of humor, and a woman's caprice; a river that goes traveling sidewise, that interferes in politics, rearranges geography and dabbles in real estate; a river that plays hide-and-seek with you today, and tomorrow follows you around like a pet dog with a dynamite cracker tied to his tail. That river is the Missouri."

The dynamite cracker is soon to be removed. The waters of the Republican, the Platte and the Solomon, the Cheyenne, Marias and Tongue, the Big Horn, the Knife and the Grand, and all the other tributaries of the Missouri, will join that parent stream in the work of developing a new frontier.

Thus Missouri Basin development is the logical sequel to the objective of all pioneers—building a new land of prosperous homes and fertile farms. In the early years of the Reclamation Service the first projects were completed in the Middle West. During the intervening years the tide of irrigation development moved westward and major projects were inaugurated and completed in areas deemed feasible for such expansion. Again the tide has turned and the Nation is witnessing a new concept in Federal Reclamation development.

But no longer are individual projects regarded as separate entities. The program now under way contemplates the development within the Missouri River Basin as one project. Each of the many units within the basin is a component part of the Missouri Basin project, interrelated and interdependent. Areas for years dependent on an agricultural economy based on one-crop dry farms will witness a change undreamed of but a few years ago, and in working out a new economy will have the full advantage of the greatest of their natural resources—the waters of the Missouri River.

WANTED: *Men to Hire*

A few, short months ago, countless servicemen, sweltering in Pacific jungles and shivering in German fields, were dreaming about cozy, white cottages, presided over by gingham-clad gals, on green little farms back in the good old USA.

Now is the time to begin making daydreams come true!

This summer, and in the years ahead, thousands of veterans of World War II will pitch in to help the Bureau of Reclamation make soldiers' dreams come true by carving out of parched and often desert land, new farms, business opportunities, and permanent jobs by developing the land, water, and other resources of the West.

Some of these men are finding careers as engineers, scientists, mechanics, and clerical workers on Bureau of Reclamation rolls.

Many Openings Loom

Others will find steady jobs, in the months and years ahead, with the contractors whose executives, technicians, and labor forces will build the dams, reservoirs, power plants, tunnels, canals, and other structures planned for construction under the biggest engineering and resource development program ever undertaken in the United States.

The fruits of the labor of the men and women employed by the Bureau of Reclamation and the contractors will be millions of acres of new irrigated lands and thousands of new industrial, commercial, and just plain work opportunities for enterprising young Americans.

Such ambitious fruits, of course, cannot be attained immediately, or without sound planning and hard work. Years of toil for millions of man-years of labor are ahead before they can be fully realized. But to speed the day when farm and small business opportunities will be available to veterans in appreciable numbers, the Bureau of Reclamation is putting full steam behind the big construction job that has to be done.

Some 900 veterans already have shucked battle-dress for technical and clerical jobs on Reclamation pay rolls. But there will be hundreds of new opportunities, and qualified men and women are being sought to fill them. The recruiting is now going forward in the seven regional offices of the Bureau, and by the Chief Engineer, with preference being given to war veterans.

Veterans in Majority

More than 75 percent of all new employees of the Bureau of Reclamation are veterans. However, one needs more than just his discharge papers to get a job. The Bureau of Reclamation has a tough, technical job to do, and the qualifications for the men and women it hires must be tough, too, if the job is to be done successfully.

Candidates must be of good character, capable of learning fast and of doing hard work. And, for most of the technical jobs, varying amounts of education and experience are required.

Engineering aide positions are now open to veterans with from three months to a year of training or experience in drafting or mechanical drawing or surveying. These positions pay up to $2,980 per year. Aides assist in surveys, in plotting notes and setting up apparatus. Scientific aides, with training or education in chemistry, geology, mathematics, or physics, work in the huge laboratory at Denver making engineering tests and experiments.

In some instances, a work-and-learn plan has been coupled with the Bureau's effective promotion-from-within policy, so as to enable employees of outstanding ability to work, learn, and grow with the organization. In some selected localities, arrangements have been made with western colleges and universities for a limited number of veterans of promise to go to school part time and work part time in Bureau offices or on projects. Although this plan was developed to meet the increasing need for technically trained personnel, the program has been extended to nonengineering fields, as well.

Engineers Needed

Most urgently needed to keep the Reclamation program forging full steam ahead are hydraulic, civil, electrical, mechanical, structural, and architectural engineers. Some of the jobs will pay salaries as high as $6,230 per year, and others will range downward to the beginner's pay.

All of the Reclamation positions now being filled are listed as temporary under the civil-service regulations. However, new employees will be given an opportunity to compete in examinations for acquiring permanent civil-service status. In such competition, honorably discharged veterans will have a five-point preference, and disabled veterans a 10-point preference.

All of the jobs outlined are in the West—not in Washington, D. C.

Inquiries regarding employment may be sent to the Bureau of Reclamation, Room 457, New Customhouse, Denver 2, Colo., or to Bureau regional offices at Boise, Idaho; Sacramento, Calif.; Boulder City, Nev.; Salt Lake City, Utah; Amarillo, Tex.; Billings, Mont.; and Denver, Colo.

WHAT'S A LITTLE SNOW TO AN ENGINEER?—*Charles L. LeFeber, shown here with a transit, is locating an access road to the Hungry Horse Dam on the South Fork of the Flathead River in northwestern Montana. Preconstruction studies for this project were carried forward during the early spring by Bureau of Reclamation engineers despite deep snowdrifts and generally adverse weather conditions.*

Reclamation Faces the Peace

By MICHAEL W. STRAUS, *Commissioner of Reclamation*

There is a single goal which dominates all peacetime activity of the Bureau of Reclamation. Our target is to bring about the soundest resource development of the 17 Western States. In this undertaking the Bureau of Reclamation has the confidence of the majority of the people.

One of the chief means by which it offers assistance in western economic development is through its comprehensive surveys and reports on river basins. The Bureau is now engaged in drafting blueprints for integrated development in 14 of these major river basins of the West. In performing this task we realize that every region, every State, every town, and every individual affected by these plans has a right and duty to express an opinion regarding them.

Democratic Safeguards

Channels are being established through which this can be effected in a manner that will produce a working plan satisfactory to most of the people, and which will be in conformity with State and local laws. Intense effort is being put forth in studying the problems involved and in endeavoring to resolve conflicts of interest. No attempt will or can be made to force a plan upon the citizens of any area. The work is being done entirely in their interests. Safeguards are written into law and Bureau regulation to require expression by the affected local, State and Federal Government before work is undertaken with the approval of Congress. All the safeguards of democratic procedure are assured.

History-Making Program

To help the West and the Nation meet the peacetime needs for agricultural and industrial expansion, the Bureau this year is undertaking the largest construction program in its history. Work interrupted by the war is being resumed on 28 major projects which will cost more than a billion and a half dollars to complete.

Funds totaling approximately $160,000,000 have been made available to the Bureau for the fiscal year ending June 30. Of this total, $147,766,900 will be spent on the construction of dams, irrigation systems, power plants, transmission lines and other engineering works.

We are starting work on the comprehensive development program for the Missouri River Basin. A contract has been awarded for construction of Kortes Dam and power plant on the North Platte River in Wyoming, the first of 29 projects to be built by the Bureau under the coordinated plan approved by the Congress in 1944. We are also resuming full-scale operations in developing the million-acre Columbia Basin project in Washington State, the Central Valley project in California, the Colorado-Big Thompson project in Colorado, and on other Reclamation developments in the West.

While major emphasis will be on construction, the Bureau also is carrying out an accelerated program to complete its detailed engineering and economic investigations on projects which have possibilities for development in the future, and on the comprehensive river basin reports.

Many Hurdles Ahead

We are well aware that many obstacles will have to be overcome to attain the objectives that have been set. Progress of the construction program will be dependent upon our ability to get the building materials, machinery and equipment. There will be difficulty in obtaining housing for administrative and construction employees. We will need to recruit and train a much larger Bureau staff, especially in the various engineering fields. The Bureau of Reclamation in coming months will experience all the aches of postwar growing pains.

In carrying out its resource-development plans, the Bureau of Reclamation is working as an agency within the Department of the Interior with certain definite duties assigned to it: These are:

1. The responsibility for constructing irrigation projects which will bring much-needed water to arid and semiarid regions in which agriculture could not flourish without engineering works to store and distribute water.

2. The duty of providing municipal water supplies where irrigation projects make this possible, in order that city and town populations may continue to expand, and new industries may be established in and around them.

3. The duty to produce low-cost power, and, where economical, to distribute it so that countryside and town may reap the greatest benefit.

From these principal duties there has developed an important secondary responsibility—that of making available for recreation purposes the man-made lakes which are formed behind the irrigation and power reservoirs. Here the National Park Service of the Department of the Interior steps in to supply its skill in the administration of recreation parks where boating, swimming, and fishing can be enjoyed by people in the immediate area and tourists from all over the country.

By assuring a steady flow of water in many western streams which in the summer months run dry, the engineering works of the Bureau of Reclamation also make it feasible for the Fish and Wildlife Service to stock these streams with game fish and to provide refuge for duck, geese, fur-bearing animals, and other forms of wild creatures.

There is a tie also to the work of the Interior Department's Grazing Service, which is restoring the once rich grazing lands of the West, and helping to reduce soil erosion and thereby lessen the amount of silt that muddies our rivers and gradually fills up the reservoirs that we build.

Broader Program Assured

But the program which the Bureau of Reclamation is proposing goes beyond the activities of the Department of the Interior. So broad a plan of development requires the full cooperation of the Corps of Engineers of the War Department, charged primarily in peacetime with work on our rivers and harbors. Its work in flood control and navigation dovetails into our program of water conservation. On the irrigation and power development aspects of its program, the Bu-

(*Continued on p. 107*)

Ideas Go Traveling

By WILLIAM E. CORFITZEN *

Whenever construction is completed on a Reclamation project and the first trickle of water brings promise of fertile fields to a thirsty desert, it probably will be found that some engineer from a country thousands of miles away, through research and contribution of knowledge to engineering science, helped make this man-made miracle possible.

Some irrigation farmer in the rice paddies of China or on the plantations of South America may be using American methods and equipment to lift the fear of famine from his land because somewhere in the United States an idea was shared.

In the future the agricultural economy of some distressed foreign land may become stabilized, thus returning to its people their ability to support themselves and raising the standard of living of thousands of families, all because a common scientific interest in reclamation cuts across international boundaries.

The established policy of the United States Government has favored extending the fullest practicable cooperation to our allies. In accordance with this policy, the Department of the Interior has its own program leading toward a mutual exchange of scientific knowledge pertaining to reclamation projects throughout the world.

*Chief of Special Assignments Section, in charge of foreign activities for the Bureau of Reclamation.

Plans Made for Yangtze

During the war, Dr. John L. Savage, Chief Designing Engineer in connection with Boulder, Grand Coulee, Shasta and many other Bureau of Reclamation dams, was authorized by the Department to go to China at the request of the Department of State and under its auspices to assist the Government of China in making a preliminary reconnaissance of the great Yangtze River Basin. Out of his visit has grown the request of the Chinese Government that the Bureau undertake preparation of plans and specifications for development of the Yangtze. China already has paid a first installment of $250,000 for this service.

The benefits of such an arrangement to the United States and China cannot be measured in terms of dollars and cents. Who would dare evaluate the prestige and good will gained by our country through the visit of one of the greatest designing engineers of the world to the as-yet untamed Yangtze River? And who can measure the wealth of knowledge brought back by Dr. Savage about Chinese methods of reclamation? A development such as that planned for the Yangtze River Basin is closely linked to stabilization of China's national economy.

The engineers and scientists of the United States lead the world in the particular skills and experiences in the fields of irrigation, power and flood control; these are, moreover, activities in which the Bureau of Reclamation has become outstandingly proficent. But there is always much more to be learned. By applying their special skills to an unusual problem, here or abroad, our engineers and scientists gain new techniques. By exchanging ideas and experiences with scientists from other countries, we add to our own fund of knowledge.

AMERICAN DESIGNING ENGINEER IN CHINA—*John Lucian Savage, renowned designer of Bureau of Reclamation Grand Coulee and Boulder Dams, surveys the Yangtze Gorge from a sampan accompanied by Chinese engineers and officials. When this preliminary survey was made in 1944 Japan was still hammering at the Chinese. Many tributaries important to development of the Yangtze were in their hands.*

Boulder World-Famous

The idea of exchanging scientific techniques in the realm of reclamation is not new. The fame of Boulder Dam gave the impetus to world-wide recognition of the skill and resourcefulness of our Reclamation engineers. Before that time a scattering of visitors from foreign countries took advantage of the opportunity to see what was going on in our irrigation projects. Our engineers, whenever possible, rounded out their experience and training by looking over irrigation works in other parts of the world or by taking advanced engineering courses abroad. However, 1930 saw the first significant indication that engineering experts were looking to the United States for leadership in matters pertaining to water resource development.

Boulder Dam has been international news from its very beginning. Engineers had to work out unprecedented plans and designs in a realm beyond that covered by their standard handbooks. They had to abandon standardizations for 100 and 200-foot dams and prepare design data for a structure over

700 feet high. They had to explore beyond the known ranges of safety, not daring to take chances. An error leading to failure of the dam might have resulted in wiping out a large part of the southwestern United States. Setting up models, working out plans and designs and going into construction involved difficulties far beyond any contemplated on construction jobs up to that time.

That they succeeded is history. How they succeeded constitutes a momentous volume of engineering daring and know-how which can be used for the improvement of man's physcal environment—whether he live in Colorado or Afghanistan. For whenever a problem was faced and conquered, our scientists wrote technical memoranda to the Bureau of Reclamation's Chief Engineer and a few wrote articles for the technical press. The articles were immediately picked up by papers abroad and technicians bombarded the Chief Engineer with requests for additional information. Many of these men were not content with reading—they had to see for themselves. The result was a stream of visitors who came to marvel at Boulder Dam, then Parker, Shasta, Grand Coulee, and the many other outstanding projects of the West. Between 1935 and 1941 over 500 engineers from foreign countries visited Bureau of Reclamation projects. Correspondence was carried on with scientists all over the world.

CHINESE ENGINEERS IN AMERICA—*Five Chinese engineers inspect a portion of the 69-inch pipe to be laid in the 41-mile Salt Lake Aqueduct, a major feature of the Bureau of Reclamation's Provo River project. They are part of the group of 25 graduate engineers from China participating in the Bureau's trainee program.*

More Visitors Due

During the war, censorship, restrictions on travel, and wartime security regulations put an end to this give-and-take relationship with scientists from other lands. As soon as the tide of battle turned, requests began coming in for resuming such activities. The State Department and foreign embassies began to realize that the widespread interest in Bureau of Reclamation projects opened up unlimited possibilities for a great program of international exchange of scientific reclamation knowledge.

Gradually procedures were worked out so that the utmost in mutual benefits could be assured. Now, foreign scientists need not cool their heels in anterooms and offices trying to find out whom they should see to get permission to visit Reclamation projects. There is a clear-cut arrangement which has been agreed upon by the State Department, the embassies and the Department of the Interior. The scientist goes first to his own embassy, states who he is, his mission, what he is most interested in seeing, and why. The embassy then forwards the request to the State Department, which checks on the visitor and informs the Department of the Interior and the Bureau of Reclamation. In this way, the scientist is entitled to full consideration in planning his itinerary, and the Bureau of Reclamation is prepared to give him the material he wants.

During 1945 over 800 visits were made by foreign scientists and technicians to Reclamation projects. Requests were received from 29 governments for permission to allow 172 accredited visitors to take advantage of the vast knowledge compiled by the Bureau. No tourists were allowed to visit Reclamation projects during the war, but hundreds now are expected as transportation becomes available.

Trainee Program Widely Accepted

The Bureau's trainee program is one forward-looking step toward international cooperation. Twenty-five trainees already have been accepted from China, one from Mexico, one from Egypt, and several from India. Under this plan, highly qualified scientists from foreign countries are put to work on Reclamation projects where they receive on-the-job instruction and training in American methods. These trainees are all university graduates, experienced in their particular lines of work. They receive no compensation for their services while in training other than allowances from their own government. They do not displace American workers while in training. In fact, this matter has been taken up with the unions by the International Training Administration which referred the trainees to the Bureau. The unions are in favor of the plan. So is American industry. When these English-speaking, American-trained engineers return to their own countries they will know how to use American equipment and methods and recommend them to their own countrymen.

The unions, as well as the manufacturers, have nothing to lose and much to gain from this program. Our own engineers, working side by side with these semiofficial ambassadors from foreign lands, are in turn learning a great deal from the trainees because of their varying backgrounds and experiences and the challenging problems they present in seeking to apply knowledge gained in America to the improvement and conservation of their native soil.

Cooperation Benefits All

Never before in the history of the world have nations been drawn so close together. As never before, we are beginning to realize our interdependence upon one another. "One world or no world at all" has frightening, yet hopeful connotations for the future of civilization. In its program for international cooperation, the Bureau of Reclamation is adding to the world-fame of its engineering accomplishments. We are learning from others that we may enrich our own learning. We are benefiting from the problems and experiences of others. We are opening up new outlets for foreign trade. We are paving the way for greater understanding of the problems of other nations. These are but a few of the mutual benefits arising from a well-rounded and organized program of international cooperation.

Predictions and Potatoes

There is a direct connection between the big, brown Idaho baked potato on your plate, in a dazzling Broadway restaurant and the lonely job of the fur-clad men on skis who measure the depth and weight of the snows in the far away Teton and Cascade mountain ranges.

The farmer who grew that potato probably would not have planted the seed had not the men on skis and their fellow technical workers assured him that the melting mountain snows would provide enough water to grow his crop.

Out in the Idaho potato country, as throughout most of the West, the rainfall is too meager to grow crops. Water from the melting snows and the wet season rainfalls up in the mountains must be conserved in huge reservoirs and carried through canals to the fields in the fertile, but parched, valleys.

Plenty of water in the Bureau of Reclamation's reservoirs for late fall irrigation means the difference between growing 300 sacks of Idaho's giant tubers and producing the mere 50 sacks or so that will result if the water is low.

If the spring forecast looks good for a full water supply late in the growing season, the farmers will drop their potato cuttings in long rows over thousands of acres of western lands that depend upon irrigation for water. But if a water shortage seems probable, they will not plant so many potatoes. Instead, they will put in other crops that mature early or require less moisture late in the season.

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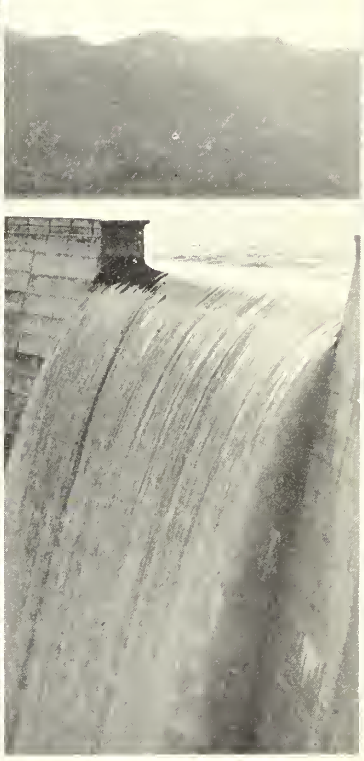
THE MAN AT THE SOURCE—*Ole Overlie (left), superintendent of the Bureau of Reclamation's Deadwood Reservoir in the Cascade Mountains of central Idaho, shown measuring the winter's snow, is one of the many men who travel the lonely, often dangerous "snow courses" to help ascertain how much irrigation water will be available for the summer's crops. Snowbound 8 months each year, his only contacts with civilization are the two-way radio, the telephone, when it works, and the airplane that brings him mail and supplies once a month (upper panel, right page). The central panel, right page, shows his big woodpile, the living room of his snug cabin, and the dam at Deadwood Reservoir, which conserves the waters from the snows Overlie measures. From the fruits of Ole Overlie's lonely job, farmers, like the one cultivating potatoes in the field in the lower panel, can plan their crops and tillage so as to make best use of the available water.*


15 DOZEN
EGGS



Predictions and Potatoes

(*Continued from p. 101*)

Furthermore, the farmer must know what the water conditions will be throughout a season, if he is to plan his cultivation to the best advantage.

So, a wrong guess on the water supply not only would spell trouble for the farmer, but you might not be able to get your potatoes—at least not at a price you would want to pay. This goes not only for potatoes, but for other foods grown on farmlands that depend upon irrigation for moisture.

And, on the accuracy of the water forecast depends the success of the management of water in Bureau of Reclamation reservoirs for controlling floods, generating power, and other uses.

By measuring the winter's snows, checking the rainfall over the watershed, gathering knowledge as to the vagaries of the weather, the types and condition of the soil, and other data, and by the use of scientific methods for interpreting this information, technicians have learned how to guess, with fair accuracy, how much water will be available in Reclamation reservoirs throughout a season. They have learned how to detect the probability of floods, and to anticipate the likelihood of water shortages.

Because of the many complex forces of nature that must be considered, water predicting has not yet become a sure-fire, foolproof science. The Bureau of Reclamation, in cooperation with other Federal, State and certain private agencies, now is organizing a forecasting service that will afford Reclamation water users the best information that science can give.

A service already is functioning for projects now in operation, but it is to be improved and expanded to meet the needs of the Bureau of Reclamation's huge peacetime program. Technicians will be trained and data needed in making predictions will be collected, so that the service can be instituted as the projects are completed and go into operation.

Snow Measurement Basic

Although the measurement of the snow, at proper times and specified places, is but one of the several factors used in forecasting water conditions, it is the basic factor. In performing this cold, lonely task, the men on skis and snowshoes, cover long "snow courses" miles away from civilization.

For instance, in the Teton Mountains of Idaho, Reclamation employees cooperate with the men of the Forest Service and the National Park Service in taking snow measurements in February, March, April, and May. Sometimes the weatherman cooperates, but often he sends blizzards.

One of the longest "snow courses"—chains of stations at which snow measurements are made—is covered by employees of the Minidoka project, who live at the Jackson Lake Reservoir in northwestern Wyoming. The course includes the area north of Jackson Lake to Lewis Lake Divide in the southeastern Yellowstone Park, and from Jackson Lake to Twogwotee Pass in the east, along the Buffalo River in Wyoming—a round trip of about 210 miles. Measurements are taken at 15 stations.

For many years, this dangerous trip was made by men on skis. But the machine age has caught up with the snow survey, and the trip is now made in a sleek little "snoplane." This is a small "tricycle on skis" with a tiny cabin, a 65-horsepower airplane motor and a pusher type propeller.

James L. Braman, Jackson Lake Reservoir superintendent, one of the men who makes the trip over the "snow course" in the "snoplane," says, "She works like a dream, but we have to be careful not to wrap the propeller around a pine tree. If it only had wings. . . ."

Our Back Cover

HERE ARE THE SNOWS OF YESTERYEAR—*Plunging over the walls of Grand Coulee Dam into the "Devil's Punch Bowl," these picturesque waterfalls can be seen during a spring thaw. Besides offering the sightseer a glimpse of transient beauty, these springtime cascades bring promise of full reservoirs and flourishing irrigated lands in the Columbia River Basin. In Canada the headwaters of the Columbia River rise in high mountain snows, glaciers and lakes, having the effect of regulating the river flow and bringing June and July high-water periods which are highly advantageous to both irrigation and power development on the Columbia Basin project.*

Braman's longing for wings is explained by his fellow workers as nostalgia for his old job behind the tail gun of a B–17.

But the grounded ex-tail gunner can remember back when he was really on the ground. He used to do the 210-mile course on snowshoes and skis.

Food Cache Gone

"We always had to gamble on the weather, then," he says. "We would start out in sunshine and find ourselves in a blizzard in a day or two. Then we would get to a shelter cabin and find out that somebody had already eaten up the food cache."

Glenn Simmons drove the "snoplane" while Braman was busy keeping the Krauts off the tail of his B–17. Simmons, a husky, 225-pounder, now assistant superintendent of the Minidoka project, praises the "snoplane" highly. "A trip that takes 10 days on skis can be made in three days in the 'snoplane.' We pile in our skis, snowshoes, extra clothing, gasoline, food and snow-measuring equipment, and skim right over the top of the drifts. If the grade is too steep we unload the 'snoplane,' drive to the top, and come back in the same tracks. Then we load up again, and zip right up to the top without any trouble."

On the western side of the Continental Divide, George Pilcher, superintendent of the Bureau's Island Park Reservoir in northeastern Idaho, daydreams about Braman's "snoplane" while he travels his own long snow course on skis and snowshoes.

"I used to rent a dog team, back in the days when we could find one," he explained. "But they disappeared during the war. Sometimes I can thumb a ride on the mailman's snow tractor, but usually I have to 'web it' on snowshoes."

Pilcher's snow course covers a 50-mile round trip; on stormy days, it seems like 100. Snow is an old story to Pilcher, who placed third and fourth, respectively, in the American Dog Derby at Ashton, Idaho, in 1923 and 1924. He carries his snow-measuring equipment on his back, with his food and other supplies.

Snow Can Be Sampled

"We use standard Federal equipment in measuring snows," Pilcher said. "First, we have the snow sampler—a duralumin tube, in two and a half-foot sections. It can be assembled into a tube 20 feet long. It has a cutter in one end and a scale, in inches, marked on the outside. The snow core it takes is 1.485 inches across, and an ounce of snow core equals 1 inch of water content. You twist the cutter into the snow until it strikes the ground, pull out the snow-filled tube and weigh it on a spring balance. Subtract the weight of the tube and you can figure the water-content of the snow. The depth of the snow is measured by the scale on the outside of the tube."

Snow surveys made by many men like Braman, Simmons and Pilcher are the basis for the accuracy of the water supply forecasts. A 12-foot snow blanket does not insure irrigation water for the entire season. If the ground is frozen beneath the snow pack, a quick run-off occurs during the melting period and there is danger of spring floods. Ski enthusiasts favor fine, powdery snow, but its lack of water brings worry lines to the brows of grange members.

Ideal snow conditions for the irrigation farmer include a heavy fall of wet snow upon unfrozen ground. The water sinks into the earth during the melting period, and later causes a gradual runoff into streams and reservoirs.

Teton region snowfall data and forecasts are combined with those from 100 other stations in Idaho, Nevada, Montana, Oregon, and Washington, to make a complete report on the entire Columbia drainage area. Nine Federal agencies, six water power companies, nine irrigation districts, two cities, a sugar refining company, and two departments of the Canadian Government cooperate in making the surveys. Similar surveys are made for all the other major river basins of the West.

Reclamation Faces the Peace

(*Continued from p. 101*)

reau of Reclamation works with the Department of Agriculture and the Federal Power Commission.

We believe there is a need for expanding agriculture in the West, where farming depends largely upon irrigation. This is so partly because the economic expansion of the West continues to benefit the entire Nation, and partly because our growing population will require all good farming resources that can be developed.

Reclamation projects are an investment for the future. They pay for themselves many times over. Money spent upon such enterprises is returned to the Federal Treasury through annual payment of construction charges, the sale of water and electric energy, and through income and profits taxes arising from the wealth-producing agriculture and industry such activity establishes. There is no investment the taxpayers can make that will yield greater dollar returns.

Foresighted planning which conserves these resources and prevents their waste is essential, if we are to continue to be a great nation. All over the world today a consciousness is growing that the full development and conservation of natural resources is necessary for economic and political health. If we are blind to this challenge, the day most certainly will arrive when our leadership in the modern world will diminish.

Water Forecast

Prediction of Irrigation Water in 1946

Brim-full reservoirs, full-flowing streams and heavy snow blankets over the mountains promise plenty of 1946 irrigation-water for all of the Western States except southern California, southern Colorado, Arizona, and New Mexico.

Ground-water and stream-flow measurements for March by the Geological Survey of the Department of the Interior range from 200 percent of normal in north Nevada to as low as 12 percent of normal in northeast Arizona.

Stream flows in March approached flood conditions in Nevada while near-drought threatens Arizona, southern California, New Mexico, and southwest Colorado.

Stream flows and well-levels are plotted on the map reproduced below. Wells show the depth to ground water. Small circles with a line drawn out from them like the hour hand of a clock, indicate measurements of well-levels. The hour hand at 12 o'clock means that wells in that area are abundantly full of water. The hand at 3 o'clock denotes normally full wells, while very low levels are shown by the hand at 6 o'clock. Where wells are heavily pumped the indicating circle is solid black.

Unusually heavy March stream flows are shown by cross-hatching whereas dotted areas indicate unusually low stream activity.

The figures represent percentages of normal March stream flow. Thus, 109 appearing on the map means that streams in that vicinity were running at 109 percent of March average, or 9 percent above normal. The figure 37, on the other hand, denotes streams at only 37 percent of normal or 63 percent below the median March flow.

Water stored in all important Bureau of Reclamation reservoirs on March 31 of both 1945 and 1946 is shown by the following table.

Depth of snow and its water content are measured by surveyors traveling by snow plane, dog teams, or afoot with skis and snowshoes. Surveyors cover much of the mountainous area of the West, taking representative snow samples.

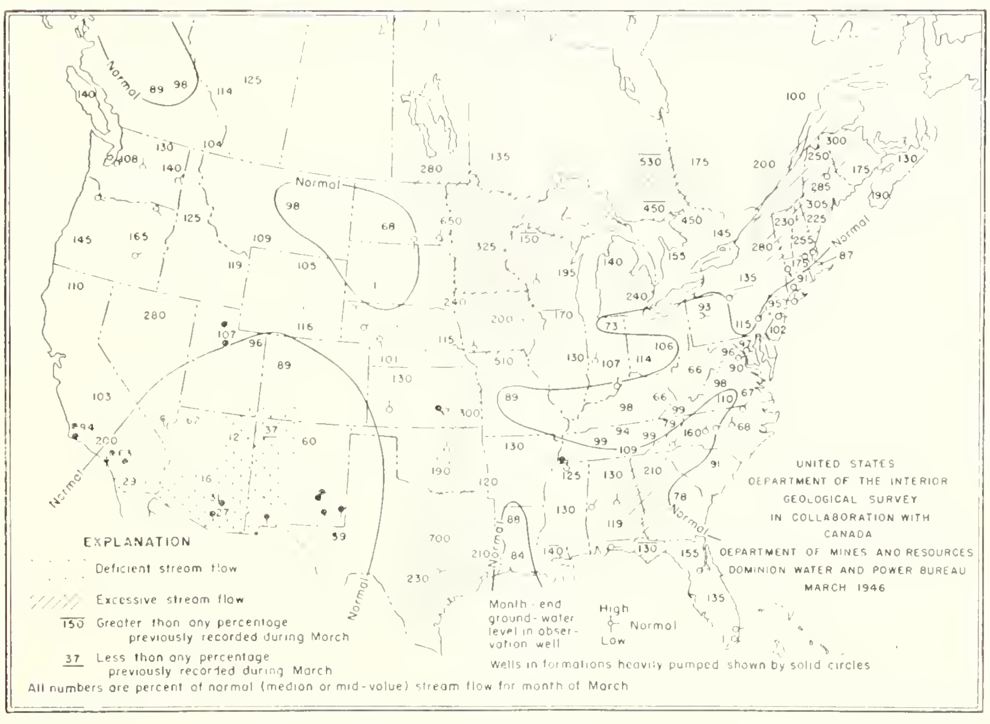
Snow surveys must be counted in to make up the water prediction for the coming summer. When it is totaled with ground water level and stream-flow measurements, an accurate picture of water conditions during the ensuing irrigation season results.

Although snow-survey reports are not yet all in, preliminary reports indicate that the snow cover and its water content are above normal in Washington, Idaho, Montana, Oregon, and Wyoming; are normal or slightly below normal in California, Nevada, Utah, and northern Colorado, and are subnormal in southern Colorado, Arizona, and New Mexico.

Adequate to abundant water supplies in all the great western water basins are expected with exception of the lower Colorado River Basin (including Verde, Salt, and Gila Rivers), Rio Grande and Pecos River Basins.

Water will have to be hoarded like miser's gold in the Pecos, Salt and Gila River areas.

STREAM FLOW AND GROUND WATER IN RELATION TO NORMAL



WATER STORED IN RECLAMATION RESERVOIRS

Location	Project	Reservoir	Storage (in acre feet)		
			Capacity	Last year (Mar. 31, 1945)	This year (Mar. 31, 1946)
Region 1	Baker	Thief Valley	17, 400	17, 730	17, 400
	Boise	Arrowrock	286, 500	179, 100	253, 440
		Deadwood	164, 000	69, 425	
		Deer Flat	190, 150	157, 480	153, 760
	Burnt River	Unity	25, 220	13, 140	14, 850
	Columbia Basin	Roosevelt Lake	9, 700, 000	8, 795, 000	
	Deschutes	Crane Prairie	55, 335	32, 300	39, 650
		Wickiup	180, 000	66, 900	70, 600
	Minidoka	American Falls	1, 700, 000	1, 609, 090	1, 369, 530
		Jackson Lake	847, 000	432, 630	588, 850
		Lake Walcott	107, 240	90, 290	69, 080
		Grassy Lake	15, 450	9, 220	14, 270
		Island Park	127, 645	139, 990	126, 170
	Okanogan	Conconnully	13, 000	4, 830	5, 030
		Salmon Lake	10, 500	7, 490	9, 445
	Owyhee	Owyhee	1, 120, 000	606, 420	681, 610
	Umatilla	Cold Springs	50, 000	42, 000	49, 000
		McKay	73, 800	63, 050	62, 050
	Vale	Agency Valley	59, 925	60, 000	54, 550
		Warm Springs	192, 400	90, 085	141, 100
	Yakima	Bumping Lake	37, 300	34, 230	32, 100
		Clear Creek	5, 300	5, 300	5, 300
		Cle Elum	529, 255	303, 440	180, 730
		Kachess	239, 000	127, 100	201, 250
		Keechelus	170, 500	111, 330	94, 050
		Tieton	197, 000	114, 960	118, 380
Region 2	Central Valley	Millerton Lake	520, 550	312, 394	276, 700
		Shasta	4, 493, 135	2, 141, 000	3, 214, 000
	Klamath	Clear Lake	450, 930	284, 180	295, 200
		Gerber	94, 265	60, 068	51, 600
		Upper Klamath Lake	583, 900	307, 000	334, 400
	Orland	East Park	51, 000	50, 860	51, 100
		Stony Gorge	50, 180	51, 060	51, 060
Region 3	Boulder	Lake Mead	31, 141, 755	21, 239, 000	20, 987, 000
	Parker	Havasu	716, 600	628, 850	670, 000
	Salt River	Bartlett	179, 480	90, 333	1, 700
		Cave Creek	11, 000		
		Horse Mesa	245, 140	229, 480	225, 300
		Mormon Flat	57, 850	45, 300	39, 200
		Roosevelt	1, 398, 430	699, 515	368, 300
		Stewart Mountain	69, 765	48, 200	10, 000
Region 4	Fruit Growers	Fruit Growers	4, 585		3, 655
	Humboldt	Rye Patch	179, 000		187, 100
	Hyrum	Hyrum	18, 685		15, 540
	Moon Lake	Moon Lake	49, 500	18, 620	16, 300
		Midview	5, 785	4, 600	4, 930
	Newlands	Lahontan	273, 600	270, 070	248, 965
		Lake Tahoe	732, 000	439, 200	566, 400
	Ogden River	Pine View	43, 620		13, 500
	Pine River	Vallecito	129, 675	9, 040	40, 810
	Provo River	Deer Creek	150, 000	49, 090	66, 220
	Strawberry Valley	Strawberry	283, 000	100, 770	120, 720
	Uncompahgre	Taylor Park	106, 230	60, 860	84, 500
	Weber River	Echo	73, 940	20, 050	55, 345
Region 5	Altus	Altus	151, 650	35, 500	22, 600
	Carlsbad	Alamogordo	148, 000	45, 450	31, 000
		Avalon	7, 000	4, 985	5, 205
		Lake McMillan	38, 655	1, 515	
	Colorado River	Marshall Ford	1, 933, 720		1, 002, 175
	Rio Grande	Caballo	345, 870	281, 000	251, 020
		Elephant Butte	2, 219, 280	1, 223, 900	1, 030, 900
	Tucumcari	Conchas	400, 000	244, 795	323, 340
Region 6	Belle Fourche	Belle Fourche	177, 510	136, 000	144, 810
	Huntley	Anita	400	250	425
	Milk River	Fresno	129, 090	54, 420	61, 635
		Nelson	85, 450	36, 490	28, 560
		Sherburne Lake	66, 100	22, 940	24, 085
	Riverton	Bull Lake	152, 000	52, 165	48, 320
		Pilot Butte	36, 960	18, 650	18, 800
	Shoshone	Buffalo Bill	456, 600	270, 740	349, 790
	Sun River	Gibson	105, 000	63, 610	68, 865
		Pishkun	46, 350	17, 100	22, 780
		Willow Creek	32, 400	21, 895	11, 243
Region 7	Colorado-Big Thompson	Green Mountain	154, 645	45, 270	64, 100
	Kendrick	Alcova	190, 685	25, 510	37, 500
		Seminoe	1, 026, 360	52, 860	542, 500
	North Platte	Guernsey	50, 870	37, 180	46, 600
		Lake Alice	11, 400	1, 460	
		Lake Minatare	60, 765	16, 820	32, 000
		Pathfinder	1, 070, 000	298, 270	422, 700

The Human Side

By GOODRICH W. LINEWEAVER, ***Director, Branch of Operation and Maintenance***

A REMINDER ***that dams are built for men, not men for dams, and that the Reclamation goal is happier living for a multitude.***

Building great dams and canals to make the desert bloom is only a means to an end—the end being more satisfactory lives for the people these works will serve. When undertaking to serve irrigation water to an addition 4,000,000 acres of arid land in 17 Western States during the postwar period for farms to be settled by 45,000 veterans and other families, it is our job to remember that this effort must be of the people, by the people, and for the people.

The magnitude of the Bureau of Reclamation's schedule for the next five years, under a program that has been submitted to the Congress, is illustrated by the record of the Bureau since the enactment of the Reclamation Law on June 17, 1902. During the 40 years that have elapsed since irrigation water was delivered on the first project in 1905, approximately 50,000 irrigated farms now within Reclamation projects have been carved from western waste lands and are now the main support of more than a million persons on the project farms and in the towns and villages of the project area.

This human side of the Reclamation program has been emphasized by Commissioner Michael W. Straus, who declared:

> We must make the great dams, fine canals, and other facilities serve the people for whom Reclamation projects are constructed. At the same time, we must provide settlers on Reclamation projects with low-cost water. In turn the settlers must recognize that the construction costs of the irrigation facilities must be repaid to the Federal Treasury through the Reclamation law. The Bureau of Reclamation is responsible for the successful settlement of the areas to be irrigated as the surest means by which the settlers will be able to repay the costs of construction and of the operation and maintenance of the project.

Settler's Interests First

The settlement program is under the auspices of the Branch of Operation and Maintenance, representing the Commissioner in its formulation and execution through the Regional Directors. The Branch, operating through regional counterparts, is centering its attention on ways and means of making the projects work to the best interests of the prospective settlers.

Highlighting the problem is the human angle which is considered simultaneously with the analysis of the physical phases that relate to the water supply, quality of the land, financial needs, and related factors. Irrigation farming is no sinecure. It is far more exacting than agricultural operations in the humid areas where Nature takes care of the moisture that is essential to crop production.

MR. LINEWEAVER AT HIS DESK IN WASHINGTON—*Nearly 200,000 new family-sized farms would be created on irrigation project planned by the Bureau. The two largest for postwar development are the Columbia Basin project, Washington State, and the Central Valley project, California. Mr. Lineweaver also will direct the Bureau's land-use program and serve as an adviser to Commissioner Michael W. Straus on programs for repayment to the Federal Government of nearly a billion dollars invested in projects irrigating more than 4 million acres.*

In the arid and semiarid West where the Bureau of Reclamation operates, the rainfall of from 3 to 20 inches annually is inadequate for sustained agricultural production. Irrigation through the storage and diversion of the scant water supplies of the area is therefore necessary not only to agriculture in the West but to the maintenance of civilization in that vast area in which lies nearly half of the continental land surface of the United States. While about 20,000,000 acres are now irrigated, water can be conserved to irrigate only about 20,000,000 additional acres. It is self-evident that the settlers on the first blocks that are planned for irrigation by 1950–51 have a job that challenges their modern pioneering spirit.

The compensations to the settlers from irrigation farming, however, offset the difficulties encountered through control of moisture in the soil by irrigation. Crop production can be assured to a greater extent than by rainfall. The per acre value of the output of irrigated farms averages two or three times the value of the agricultural production in the country as a whole. The returns to the irrigation farmer, therefore, make up for the higher costs of operations, including the cost of the irrigation works and the annual operation and maintenance charges for the delivery of water.

Selection Methods Planned

Consequently, the selection of the men who are to live on these farms is of primary importance. Procedures are being developed from the Bureau's experiences over the last four decades. The many, many thousands of veterans and others who are inquiring about settlement opportunities will soon be advised through all media possible.

The Branch is completing all preliminary arrangements necessary before farm units can be made available for veterans. A present complication is a potential lack of adequate housing. Facilities and materials available at the old War Relocation Centers and possibly at other wartime installations are being sought to facilitate settlement by veterans.

On the Missouri Basin project, initiation of construction on the 11 initial units depends on whether the costs allocated to the irrigation water users can be repaid within a reasonable period of time. Economic analyses are in progress in Regions 6 and 7, which include the Missouri Basin development, to assemble data necessary to determine if a repayment contract can be negotiated which will recover the funds allocated to irrigation. The Branch is also cooperating with the regional staffs on agricultural and related economic programs looking to the successful settlement and operation of the irrigated areas when water is available.

Land Buying a Problem

Another major concern of the Branch is the land purchase and development program on the Columbia Basin project in Washington, where the Bureau's goal is to have 400,000 acres under irrigation and available for settlement by 1950–51. With funds available for construction of the irrigation system to carry water from the Franklin D. Roosevelt Reservoir at Grand Coulee Dam, the land purchase and development program was launched in March by a staff of specialists in land use, community location, settlement, economics, and irrigation operations. Practically all of the 1,029,000 acres eventually to be irrigated by the project are in private owner-

ship. Activities are directed toward the purchase of land for resale to veterans and other settlers who will locate on the 15,000 or more family farms to be irrigated. Three irrigation districts have contracted to repay the construction costs allocated for repayment by the water users.

Economic Studies Under Way

On several of the older projects financial difficulties arising out of the prewar depression years or from other causes has interfered with the orderly repayment of contracted construction charges. Economic studies, including land classification, are in progress to determine the true condition of the project, and the bases for negotiating amendatory contracts.

Because the irrigable area in the public domain has been reduced so greatly, the greater part of the new settlement opportunities are in privately-owned areas for which irrigation service is to be furnished under the construction program the execution of which is dependent on congressional appropriations. During 1946–47 more than 3,500 newly irrigated farms will be in private ownership and by 1950–51 a total of 42,200 additional new farms is scheduled for irrigation service. Included in this total are 5,000 units on the Columbia Basin project in Washington.

Drawing on the experience and observations during the 40 years since irrigation water was made available on the first project in 1905, the Branch of Operation and Maintenance, so far as the Bureau's legislative authority and funds permit, has the following objectives with respect to settlement program:

(1) The permanent settlement on family-size irrigation farms of qualified veterans and others who are assigned public land units or who may become purchasers of land in private ownership. This will be sought through cooperation with the Western State colleges, the Department of Agriculture, and other agencies.

(2) All assistance possible without coddling of veterans or other new settlers. This includes placing all available information at the disposal of the settler, providing technical advice and cooperation in the clearing and preparation of raw land for irrigation farming, and assistance in roughing in of farm ditches so that crops produced may begin as soon as practicable after the settler is on the land.

(3) Full advice as to the hazards and compensations of irrigation farming, together with data on the obligation that the settler assumes when he becomes a water user on a Federal Reclamation project.

(4) Cooperation with local communities and State and Federal agencies in connection with the development of projects.

The ultimate objective of the Bureau of Reclamation and its staff is to develop the West through creation of permanent family farms on Federal Reclamation projects.

HOMES LIKE THESE *are the ultimate objective of the Reclamation program. Nels Bach, whose home is pictured here, is a member of Irrigation District No. 1 on the Lower Yellowstone project. Beginning in 1922, he has now become one of the oldest established feeders of lambs and cattle on the project.*

Subscription Rates for the Reclamation Era

In spite of increased costs, the regular yearly subscription rate for the Reclamation Era *remains at the former price of $1 a year for 12 monthly issues.*

The special rate of 50 cents a year for members of water users associations on Bureau of Reclamation projects also prevails at present.

Due to increased foreign postage rates, the subscription price for copies mailed outside the United States and Canada is now $1.50 a year.

Subscribers who had issues of the Reclamation Era *still due when the magazine was discontinued in April 1942, will receive those copies to which they are entitled. Until their subscription expires, foreign subscribers will be sent their copies with no obligation to make up the difference in mailing charges.*

These prices are subject to change, although sufficient notice will be given our readers. Subscriptions received until July 1, 1946, will be handled on the above basis.

Please notify the Reclamation Era *of any changes in address.*

(Date)

The Commissioner,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

Sir: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of ___________ for a _______ year subscription to the Reclamation Era.

Sincerely,

Check (√) if member of water users association ☐

(Name)

(Address)

(Name and address of association)

(Include zone number, if any)

Now It Can Be Told

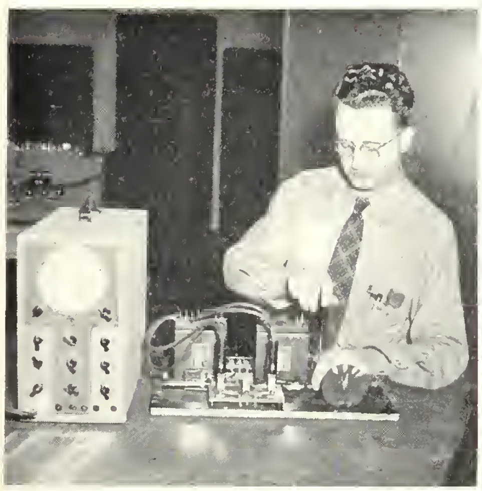
Wartime Secrets of the Denver Laboratories

By GEORGE J. VAN GIESON*

While hostilities raged on battlefronts throughout the world, the Denver laboratories of the Bureau of Reclamation were contributing toward that arsenal of war tools with which victory was won. The Bureau's scientists, engineers, and technicians, ordinarily engaged in work on Reclamation dams and canals, were called on to design new ordnance and equipment, solve a wide diversity of complex problems, expedite production and delivery of war materials, and to uncover evidence of sabotage.

An early challenge to Reclamation ingenuity was the concrete ship program of the United States Maritime Commission. This program was initiated when it appeared that the steel shortage might cut down the size of our fleets. The Bureau was called on to detail personnel to aid in the construction of concrete ships and to evolve new methods and procedures to speed up production.

*Information Specialist, Denver, Colorado.



ATOMIC ENERGIZER—*This instrument developed by Ferber R. Schleif, Bureau of Reclamation electrical engineer at Grand Coulee Dam, Wash., permitted uninterrupted flow of electricity to the power system serving the atomic bomb plant at Hanford, Wash., and other vital installations during the war. Before Schleif perfected this instrument, delivery of power from the world's largest hydrogenerators at Coulee Dam had to be interrupted periodically for tests of high-voltage indicator devices. Schleif, whose equipment permits tests and adjustments while the generators remain in service, received a $250 cash award and a salary increase for this work.*

The 102 concrete ships, barges, and lighters constructed by the Maritime Commission provided needed tonnage for our merchant and naval fleets and proved themselves in war. In October 1943, the skipper of a concrete tanker deep in the Southwest Pacific wrote his wife: "Well, kid, I almost got it the day before yesterday." The skipper didn't get it in spite of a raging inferno aboard and shellfire from an exploding PT boat alongside. The concrete ships performed admirably and were particularly valuable in naval operations in the Pacific.

Lewis H. Tuthill, Chief of Technical Concrete Control for the Bureau, was loaned to the Maritime Commission early in the war to assist in the construction of concrete fleets. While Tuthill was busy in shipyards on both the East and West coasts, investigations were carried on in the Denver laboratories to determine concrete mixes that would meet the requirements of light weight, watertightness, and high strength.

Concrete Conquers

Before a new ship could be accepted by the Martime Commission, the rigid specifications required that hulls, bulkheads, decks, and tanks be absolutely watertight. When acceptance tests were made after construction, even though only a damp spot appeared, Maritime inspectors marked it as a leak and repair was required. The Denver laboratories devised a special patching procedure to secure watertightness where imperfections appeared, thus advancing construction of these ships by days and weeks.

Naturally, the men of the sea accustomed to steel vessels were somewhat dubious of concrete ships. An engineer wrote, "When I was informed that I was to sail on a concrete ship, I could not believe it, and said I would have to see it first." A few months later, the same engineer said, "I couldn't ask for a better vessel." This was after his ship demonstrated its seaworthiness in a hurricane off Cape Hatteras. The wind was estimated at 120 miles an hour with waves rising to 100 feet in height. Despite the severity of the storm, there were no injuries to the crew or damage to the ship.

Throughout the war, officials of the Navy, Army Air Forces, Corps of Engineers,

CONCRETE SAILS THE SEAS—*Ships constructed of concrete by the United States Maritime Commission added tonnage to American war fleets. The Bureau's Denver laboratories played an important role in development of the concrete ship program.*

Chemical Warfare Service, Army Ordnance, Army Counter-Intelligence, and war industries brought many problems to the Bureau's research staff.

When the steel shortage was at its worst, Army Engineer officers responsible for constructing fuel storage facilities at Lowry Field, near Denver, called on the Bureau for help in designing concrete fuel tanks. After testing the effect of concrete on gasoline and, by the same token, the effect of gasoline on concrete, Bureau technicians determined the feasibility of using concrete tanks instead of steel tanks. Special coatings for concrete were originated by the research staff to prevent harmful reaction between the cement components and the high octane fuel used for planes. At the Army's request, a Bureau engineer supervised field construction at Lowry of the vitally important tanks. Later, similar concrete fuel tanks were built at Army air fields throughout the country.

Production Programs Aided

As the armed forces built bigger and heavier bombers, the ability of concrete runways at Army air fields to withstand increased wheel loads became an important problem. Slabs of concrete were taken from runways at over 24 Army air fields in the United States and Canada and shipped

to the Denver laboratories. These large slabs of concrete, usually 5 feet square, were placed under diamond saws and cut into beams. They then were subjected to flexure and compressive tests to ascertain accurately the properties of the concrete and its ability to withstand heavy bomber loads.

Many acceptance tests on materials, ranging from strategic metals to scrubbing soap, were made for the Navy during the war. These tests enabled the Navy to chart production of needed equipment and supplies by placing orders where materials could be readily manufactured to meet requirements. To expedite the production and shipment of pontoon barges that were so vital in numerous invasions, the Navy asked for, and received, the services of three Bureau engineers.

Global warfare meant new and intricate problems for our armed forces. One such problem was the transportation of troops and equipment over ravines in mountain areas by means of cables. These cables required special connecting fittings over which the cableway pulleys would operate smoothly. Through Bureau laboratory tests a highly efficient sweated connection for these cables was developed and proven.

Load tests of steel-encased concrete rollers for use on large span bridges were made for the Great Lakes Naval Training Center. The tests, made with the laboratory's 4,000,000-pound compression testing machine, determined that concrete rollers could be used successfully. Previously, only all-steel rollers had been used on the free end of large span bridges.

Jap Secrets Discovered

In 1944, the Japanese started floating balloons to the United States and Canada with various types of ingenious bombs attached. Although the casualty rate was low—one family of six was killed when they found a bomb while picnicking in Oregon— hundreds of the balloons reached this country. When discovered, several of the balloons and bombs were rushed to Denver where they were examined in the Bureau's laboratories to determine the mechanics of their operation and to ascertain their potential destructive capacity.

At first it was thought the balloons might have been released from submarines near our coast; but, when examination showed that they were capable of remaining aloft for possibly a week, this view was revised.

The balloons were made of paper and were spherical in shape. However, after losing considerable hydrogen, which was used to lift them, they resembled parachutes. If fact, they were mistaken for parachutes by some of the people who first observed them. The balloons were designed to operate at a height of about five miles. To make it possible for them to stay aloft for a week, a ballast-dropping mechanism operated whenever the balloons fell below operational height.

The balloons contained 36 pairs of mechanical switches connected with blow-out plugs for releasing ballast or bombs. When the balloon dropped below its operational height, an electrical contact operated by a barometer closed, releasing a sandbag or a bomb. At the same time a fuse leading to another switch was ignited. During the burning of this fuse the balloon again rose to its operational height. This process continued until all ballast or bombs had been disposed of.

The first balloons arrived at approximately the time the heavy B–29 raids started over Japan. At the Denver laboratories, microscopic examinations of ordnance marks on unexploded bombs revealed the identity of ordnance plants in Japan where the equipment was being fabricated. Bureau engineers later had the satisfaction of reading about the destruction of these plants by B–29 raids.

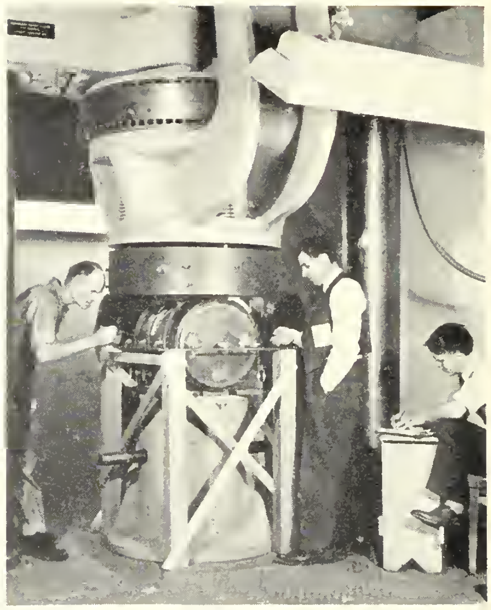
War Clues Followed

The variety of tests and experiments in the laboratories was almost endless. Much of this work was clouded in a thick cloak of secrecy and, until now, many Bureau employees have been unaware of the scope of the wartime activities of the laboratories.

Weapons used in a murder at an Army air field were examined under Bureau microscopes; architectural models of camouflaged Army bases were made in the hydraulic laboratories. Contents of fire extinguishers on planes were searchingly examined for possible foreign matter content. Even such mundane items as wiping rags from an ordnance plant were brought in for examination. In one instance, Army officials suspected that certain foodstuffs were being deliberately contaminated; through chemical analyses in the Bureau's laboratories these suspicions were confirmed.

During the war, a B–17 was on a training flight over a Western State. Unexpectedly in the space of a few minutes, the four engines failed one after the other and the plane crashed. Bureau scientists were called by the commander of an air field and asked to examine the gasoline and oil for content of foreign matter. Investigations revealed the presence of minute particles of steel shavings in the gas and oil. Whether this was the result of sabotage is still the Army's secret.

The investigations were not without their lighter moments. An Army ordnance depot requested the aid of the Denver laboratories in designing and constructing a special demolition bomb. Shortly after the Bureau offered its help, an officer appeared at the laboratories to begin work with the engineers. Then he found out he could not tell what was wanted because it was a high military secret. After an exchange of telegrams with his commanding officer, it was decided the engineers could not very well



NO RUBE GOLDBERG DEVICE THIS! *To the contrary, the Denver laboratory's 4,000,000-pound testing machine, shown here, contributed to the downfall of the Axis. Tests of steel-encased concrete rollers proved the feasibility of using them as bearings for longspan bridges for the Great Lakes Naval Training Center. Deformations of a roller were measured to an accuracy of 1/10,000th of an inch.*

design and construct a bomb unless they knew the wishes of the Army. Work then proceeded and Bureau engineers did a creditable job. The actual results still are a military secret.

Help Given Industries

Industries engaged in the manufacture of vital war material received important technical assistance from the laboratories. Remington Arms Co., the duPont Co., the Climax Molybdenum Co., and many other firms producing critical war materials called for and received technical assistance. Private and municipal power plants, turning the wheels of industry for war, were given aid on difficult hydraulic problems, railroads and similar organizations received help on special or unusual production problems.

The Bureau of Reclamation was reimbursed for work performed for other Government agencies through transfer of funds; work for outside agencies was performed under individual contracts.

The extensive facilities of the Bureau laboratories and the wide technical knowledge and know-how of the research staff, under the supervision of Robert F. Blanks, Chief of the Bureau's Research Division, were effectively translated into a contribution to national security and victory. The laboratories are a part of the Branch of Design and Construction, which is directed by Chief Engineer Walker R. Young.

The Changing Years

Bridging the Gap Since April 1942

Since the last issue of the *Era* appeared in April 1942, shortly after the Nation became engulfed in war, there have been many changes in the Bureau's organization. The Reclamation roster of today can be found on the last page of this issue.

Commissioner John C. Page's failing health forced him to retire in 1943 and he was succeeded by Assistant Commissioner Harry W. Bashore. Mr. Bashore, after almost 40 years in Bureau service, two of which were spent as Commissioner, retired at the close of 1945. Upon retiring, he said that the job ahead was a big and difficult one and that he was stepping down in favor of a younger man.

Michael W. Straus, former Assistant Secretary of the Department of the Interior, took over as Commissioner in late December 1945. He handled all Reclamation matters during his tenure of office as Assistant Secretary. All told, he has been associated with the Department for 13 years, serving in various executive capacities, including Director of Information.

Assistant Commissioners Named

Under the decentralization of the Bureau (in 1943), designed to streamline the organization for greater efficiency in meeting war and postwar problems, positions for two Assistant Commissioners were established. These are held by William E. Warne and Kenneth Markwell. Mr. Warne, a Reclamation veteran, was formerly Director of Information and Editor-in-Chief of the *Reclamation Era*. During the war he served as Assistant Chief of the WPB Drive Headquarters for almost a year. He was recalled by the Secretary to serve as Acting Director of the Power Division and later as Director of Information for the Department of the Interior. He returned to Reclamation as Assistant Commissioner in the late summer of 1943.

Mr. Markwell is a civil engineer with long and varied experience in that field. He was a Regional Director and special representative of the Director of the Federal Works Agency before coming to the Bureau in the spring of 1944. He also served as head construction engineer on the $50,000,000 Santee-Cooper project in South Carolina.

Other major changes include the appointment of Walker R. Young as Chief Engineer and Director of the Branch of Design and Construction, succeeding S. O. Harper; John S. Moore, Superintendent of Operation and Maintenance, succeeded by Goodrich W. Lineweaver as Director of the Branch of Operation and Maintenance; and Clifford E. Fix, successor of J. Kennard Cheadle, as Chief Counsel; the appointment of three well-known Bureau engineers to serve as Assistant Chief Engineers, W. H. Nalder, L. N. McClellan, and Ralph Lowry.

John L. Savage, Chief Designing Engineer, acknowledged as the world's outstanding man in his field, retired. He agreed to continue his service with the Bureau, however, as a part-time consultant. Former Commissioner Page, whose health is considerably improved, has been serving in a similar capacity, and Mr. Bashore has agreed to accept consulting assignments from time to time.

Bureau Decentralized

When the Bureau undertook development of the Western Rivers on a basin-wide scale, decentralization became necessary. When the Era was suspended, the principal offices of the Bureau were located in Washington and Denver. The departure from individual project schemes to more embracing basin-wide developments made this type of organization obsolete. Thus, it was decided to regionalize the Bureau of Reclamation. Today, instead of having all the project offices report to the Chief Engineer in Denver, who in turn reports to the Commissioner in Washington, there are seven regional offices: Region I, Boise, Idaho; II, Sacramento, Calif.; III, Boulder City, Nev.; IV, Salt Lake City, Utah; V, Amarillo, Tex.; VI, Billings, Mont.; and VII, Denver, Colo.

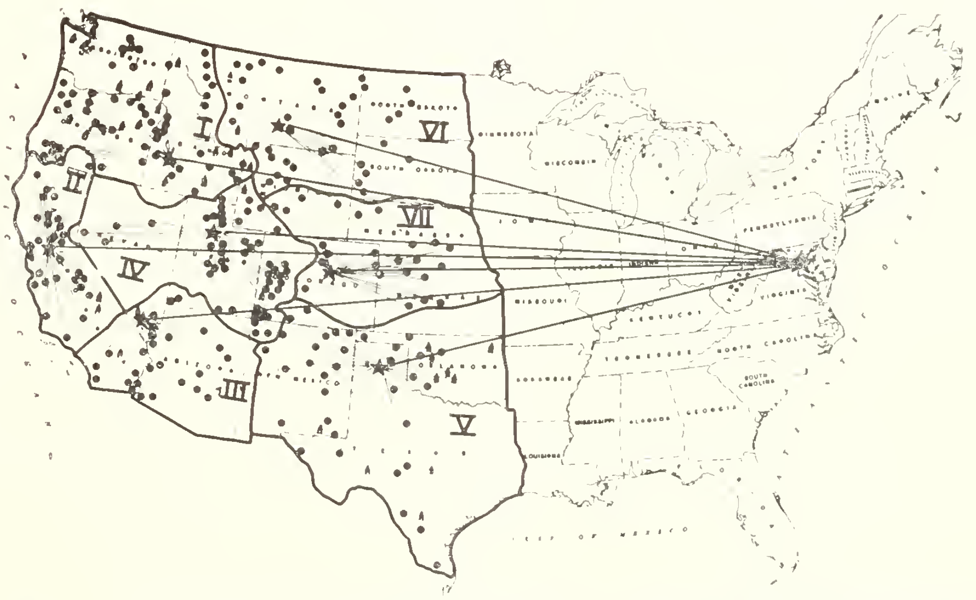
The Regional Directors who head these offices are responsible for coordinating all activities within their regions. They report directly to the Commissioner of Reclamation. They are assisted in the technical phases of their work by the technical branches, namely: Project Planning, Design and Construction, Operation and Maintenance, and Power Utilization, and by administrative facilities in the fields of management, law, finance, public information, supply, personnel, and office services, which also are centrally located. The headquarters of the Branches of Operation and Maintenance and Project Planning now are in Washington, while the Branches of Design and Construction and Power Utilization are located in Denver.

Roza Canal Completed After Ten Years

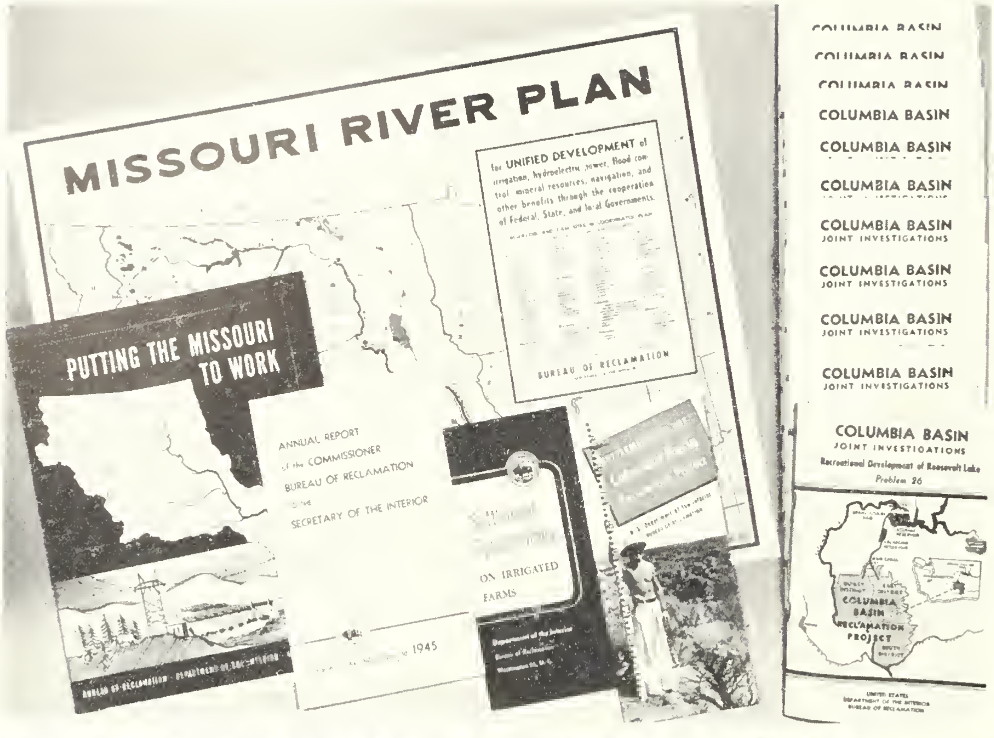
Construction of the Roza Canal, Yakima, Wash., was completed officially on March 14, when the Bureau of Reclamation accepted the contract work of the Fiorito Co. which built the last 10 miles of the 95-mile ditch, Harold T. Nelson, Roza construction engineer, announced.

Building of the canal was undertaken 10 years ago; actual work started February 6, 1936, when the Morrison-Knudsen Co. began driving tunnel No. 3.

"Mills Dam site" is the new name chosen for the Paulina Dam site of the Post project in Oregon.



HOW THE REGIONS OF THE BUREAU OF RECLAMATION ARE SET UP—*This map shows the field activities of the Bureau of Reclamation including projects under construction, authorized, and in operation during the fiscal years 1946 and 1947. Circles indicate projects, offices and field activities in the fiscal year 1946. Triangles indicates projects, offices, and field activities to be undertaken in the fiscal year 1947.*



RECLAMATION'S BOOKSHELF

Recent Bureau Publications

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River system. Fifteen cents a copy from the Superintendent of Documents, Washington, D. C.

2. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to your Regional Director.

3. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ending June 30, 1945). Obtainable on request to the Bureau of Reclamation as directed above.

4. *Boulder Dam.*—Illustrated folder on the world's highest dam. Obtainable on request to the Bureau of Reclamation at Washington or Boulder City, Nev.

5. *Approved Missouri River Plan Map.*—Color map showing reservoir and dam sites in the basinwide construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

6. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. May be obtained from the Superintendent of Documents under the following titles:

Problem 2, *Types of Farming*—75 cents.

Problem 3, *Insuring Proper Land Use*—10 cents.

Problems 4–5, *Irrigation Water Requirements*—30 cents.

Problem 9, *Farm Improvement*—20 cents.

Problem 17, *Development Rate of Project Lands*—10 cents.

Problem 19, *Highway Development*—15 cents.

Problem 21, *River Transportation*—10 cents.

Problem 25, *Rural Recreational Areas*—30 cents.

Miscellaneous Publications

"Resource Engineering" by Kenneth Markwell, in *Civil Engineering*, Vol. 16, February 1946.

Farm Irrigation Structures, by C. N. Johnston, assistant professor of irrigation and associate irrigation engineer. Circular 362, June 1945, published by University of California, College of Agriculture, Agricultural Experiment Station, Berkeley 4, Calif. 59 pp.

Irrigation Wells and Well-Drilling Methods in California, by C. N. Johnston, assistant professor of irrigation and associate irrigation engineer. Circular 361, March 1945, published by University of California, College of Agriculture, Agricultural Experiment Station, Berkeley 4, Calif. 37 pp.

The Farm Real Estate Situation, 1944–45, by M. M. Regan, A. R. Johnson, and Fred A. Clarenbach, agricultural economists, Bureau of Agricultural Economics. Circular No. 743, October 1945, United States Department of Agriculture, 47 pp., charts and tables. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 10 cents.

Letters to the Editor

Honorable Clair Engle,
House of Representatives,
Washington, D. C.

Dear Honorable Engle: On this subject of the Tule Lake land disposal, I definitely have something to say.

In regard to the system of rating used in 1937 by the Bureau to choose applicants, I certainly feel that too much emphasis was placed on capital, and too little emphasis placed on a person's experience, agricultural education, character, and industry.

Since I do not feel that the rating system used in 1937 was quite fair, I have the following recommendations and suggestions to make in devising a new rating system. I feel that:

1. *Thirty percent should be allotted to a man's past farming experience.* In this respect the 1937 system was unfair in that a man with 2 years' experience received only 10 percent while the man with 3 years' experience was given 35 percent. Thus the knowledge gained during the third year was considered to have been 250 percent more valuable than was gained in the first two years.

2. *Twenty-five percent should be allotted to a man's agricultural educational background.* In keeping with the accepted practices followed by the Civil Service and the fostering of agricultural education by the U. S. Government, a man's agricultural background should be given some consideration when being chosen for an agricultural enterprise.

3. *Twenty percent should be given a man's character.*

4. *Fifteen percent should be allotted to a man's industry.*

5. *Ten percent should be given to a man with capital up to $5,000.* A man's wealth above $5,000 absolutely must not be a factor influencing choice. Rich people are not deserving of this property. They are the most likely ones to "pull stakes" and sell out. All other factors being equal, preference should go to those applicants whose residence, for the past ten years, has been closest to the Tule Lake region because:

(1) It was their public officials who gave the most effort toward the development of this property.

(2) Their taxes went to improve the region.

In the agreement allotting this land to a person, there must be a clause stating that the recipient and his family shall live and make their home upon this claim at least 9 months of every year during the ensuing 12 years, because:

1. This property is homestead land, and should go to those who want to make and develop a farm home.

2. Recipients should be required to till this land and not rent or lease it.

I am not in accord with any kind of leases, whether they be large or small. The leasee of land as a general rule saps the soil of its plant food resources, thus reducing its productivity. * * *

Respectfully yours.

West G. Williams.

The policy of the Reclamation Era is to serve its readers by reflecting what is happening in our western Reclamation projects, and showing what people think about these events. To further this objective the *Letters to the Editor* column will become a standard feature of the Era.

For the first issue since April 1942 it seemed particularly appropriate to print a letter from a veteran. Representative Clair Engle of California kindly gave us permission to print extracts from the above, a communication from one of his constituents which was forwarded to us. In future issues we shall depend upon you to supply us with material for this column. Your letters may speak for themselves, or if calling for comment or reply, will receive the utmost consideration from the Editors of the Era. The only requirement is that the letters apply directly to problems or phases of Bureau of Reclamation activities.

Personnel and Project Directory

J. A. KRUG, SECRETARY OF THE INTERIOR

Commissioner's Office

Michael W. Straus, Commissioner — **Kenneth Markwell, Assistant Commissioner** — **William E. Warne, Assistant Commissioner**

Clifford E. Fix, Chief Counsel; T. W. Mermel, Acting Assistant to the Commissioner—Engineering; G. S. Ellsworth, Assistant to the Commissioner—Management; Barrow Lyons, Chief Information Officer; William F. Kubach, Director of Finance; Glenn D. Thompson, Chief Personnel Officer; Kenneth F. Vernon, Progress Control Officer; C. A. D. Young, Director of Supply

Branch Directors

John W. Dixon, Director, Branch of Project Planning; Walker R. Young, Chief Engineer and Director, Branch of Design and Construction (Denver); Harvey F. McPhail, Director, Branch of Power Utilization (Denver); Goodrich W. Lineweaver, Director, Branch of Operation and Maintenance

Regions (Space does not permit complete list of offices within the regions)

Regional offices	Field offices	Location	Official in charge: Name	Official in charge: Title
REGION 1—R. J. Newell, director, Boise, Idaho.	Central Snake (district).	Boise, Idaho	George N. Carter.	Acting district engineer.
	Anderson Ranch Dam.	Anderson Dam, Idaho.	Vacancy	Construction engineer.
	Deschutes	Bend, Oreg	C. H. Spencer	do.
	Yakima	Yakima, Wash	D. E. Ball	Superintendent.
	Roza division	do	H. T. Nelson	Constructiou engineer.
	Columbia Basiu	Coulee Dam, Wash.	F. A. Banks	Supervising engineer.
	Ephrata office	Ephrata, Wash	H. A. Parker	Engineer.
	Project development.	do	W. W. Johnston.	Acting supervisor.
	Minidoka	Burley, Idaho	S. R. Marean	Superintendent
	Palisades	Idaho Falls, Idaho.	I. Donald Jerman.	Project engineer.
	Hungry Horse	Kalispell, Mont	Paul A. Jones	do.
	Umatilla	Pendleton, Oreg	C. L. Tice	Reservoir superintendent.
	Rathdrum Prairie	Cœur d'Alene, Idaho.	Louis B. Ackerman.	Construction engineer
	Bitterroot	Hamilton, Mont.	T. R. Smith	do.
	Missoula Valley	do	do.	do.
REGION 2—R. L. Boke, director, Sacramento, Calif.	Central Valley			
	Kennett division.	Redding, Calif	I. C. Harris	Acting construction engineer.
	Friant division	Friant, Calif	R. K. Durant	do.
	Delta division	Antioch, Calif	O. G. Boden	Construction engineer.
	Klamath	Klamath Falls, Oreg.	E. L. Stephens	Superintendent.
	Orland	Orland, Calif	E. R. Asdell	do.
	Project planning	Santa Barbara, Calif.	J. H. Fertig	Engineer
REGION 3—E. A. Moritz, director, Boulder City, Nev.	All-American Canal.	Yuma, Ariz	J. K. Rohrer	Acting construction eugineer.
	Gila	do	J. K. Rohrer	do.
	Yuma	do	W. A. Boettcher.	Superintendent.
	Coachella Canal	Coachella, Calif.	C. S. Hale	Division engineer.
	Boulder Canyon	Boulder City, Nev.	C. P. Christensen.	Director of power.
	Davis Dam	Kingman, Ariz	H. F. Bahmeier.	Acting construction engineer.
	Parker Dam Power.	Parker Dam, Calif.	S. A. McWilliams.	Construction engineer.
	San Diego	Escondido, Calif	R. B. Ward	Engineer.
	Project planniug	Phoenix, Ariz	V. E. Larson	Assistant regional planning engineer.
REGION 4—E. O. Larson, director, Salt Lake City 8, Utah.	Eden	Rock Springs, Wyo.	E. V. Hillius	Chief clerk.
	Grand Valley	Grand Junction,	T. L. Sundquist	Superintendent.
	Mancos	Mancos, Colo	A. W. Bainbridge.	Resident engineer.
	Newton	Logan, Utah	E. J. Wick	Engineer.
	Pine River	Bayfield, Colo	S. F. Newman	Reservoir superintendent.
	Provo River	Provo, Utah	L. R. Dunkley	Construction engineer.
	Scofield	Price, Utah	P. R. Neeley	do.
REGION 5—W. R. Nelson, director, Amarillo, Tex.	San Luis Valley	Monte Vista, Colo.	D. M. Forester	Project engineer.
	Valley Gravity	McAllen, Tex.	C. P. Seger	Area planning engineer.
	Tucumcari	Tucumcari, N. Mex.	M. P. Starr	Acting construction engineer.
	Altus	Altus, Okla.	H. E. Robbins	Construction engineer.
	Rio Grande	El Paso, Tex	L. B. Fiock	Project superintendent.
	Ysleta office	Ysleta, Tex	F. D. Postle	Division superintendent.
	Las Cruces	Las Cruces, N. Mex.	E. S. Mayfield	do.
	Carlsbad	Carlsbad, N. Mex.	T. B. Thomas	Acting project superintendent.
REGION 6—H. D. Comstock, director, Billings, Mont.	Belle Fourche	Newell, S. Dak.	S. T. Larsen	Superintendent.
	Buffalo Rapids	Terry, Mont	W. L. McClure	Acting construction engineer.
	Fort Peck	Fort Peck, Mont.	Alleu Mattison	Resident engineer.
	Intake	Terry, Mont	W. L. McClure	Acting construction engineer.
	Milk River	Malta, Mont	H. W. Genger	Superintendent.
	Rapid Valley	Rapid City, S. Dak.	H. V. Hubbell	Construction engineer.
	Riverton	Riverton, Wyo.	D. L. Carmody	Superintendent.
	Shoshone	Powell, Wyo	L. J. Windle	do.
	Heart Mountain division.	Cody, Wyo	W. L. Kemp	Construction engineer.
	Sun River	Fairfield, Mont	C. L. Bailey	Superintendent.
	Missouri River			
	Project development staff.	Billings, Mont	W. E. Rawlings	Supervisor.
	Boysen Dam	Thermopolis, Wyo.	R. S. Lieurance	Project engineer.
REGION 7—E. B. Debler, director, Denver, Colo.	Colorado-Big Thompson.	Estes Park, Colo.	C. H. Howell	Project engineer.
	Mirage Flats	Hemingford, Nebr.	D. J. Paul	Construction engineer.
	North Platte district.	Casper, Wyo	I. J. Matthews	District engineer.
	Missouri Basin			
	Frenchman-Cambridge.	McCook, Nebr.	H. E. Robinson	Project engineer.
	Kortez (under North Platte district)	Casper, Wyo.	I. J. Matthews	District engineer.
	Project planning	Grand Island, Nebr.	P. L. Harley	Engineer.
	do	Pueblo, Colo	B. F. Powell	do.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official: Name	Operating official: Title	Secretary: Name	Secretary: Address
Baker	Lower Powder River irrigation district.	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke.	Notus, Idaho.
Burnt River	Bnrnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Husou, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D. G. Leslie	Superintendent.	C. J. McCormick	Grand Junction, Colo.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Norval T. Kitchen	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	do

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users—Continued

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Lower Yellowstone	Board of control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niehauer	do	M. A. McCarthy	do
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery	do
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	do	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Philip Hiibel	Superintendent	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr.	President	Joseph R. Tuddenham	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Oshack	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent	Charles G. Klingman	Gering, Nebr.
	Goshen irrigation district	Torrington, Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	Arlie S. Campbell	do	William T. Davis	Brigham City, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	H. J. Lawson	Superintendent	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen	President	Joseph H. Thompson	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	do	E. F. Andrews	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo F. Clark	do	F. A. Baker	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hansen	Manager	A. R. Hansen	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

Notes for Contractors

Specification No.	Project	Date contract awarded	Description of work or material	Contractor		Contract amount
				Name	Address	
1139	Shoshone, Wyoming	Mar. 13	Transformers, switching equipment, and current transformers for Hot Springs County REA Substations.	General Electric Co	Denver, Colo	[1] $11,862.18
		Mar. 16	Power circuit breaker and lighting equipment for Hot Springs County REA Substations.	Westinghouse Electric Co	do	[2] 2,853.76
1143	Central Valley, Kennett division, California.	Mar. 1	One 230-ton, double trolley, motor-operated traveling crane with lifting beam for Keswick power plant.	Cyclops Iron Works	San Francisco, Calif	100,310.00
1144	do	Mar. 9	230-kilovolt oil circuit breakers with automatic reclosing equipment and lightning arresters.	General Electric Co	Denver, Colo	[3] 221,194.10
		Mar. 9	Disconnecting switches for Shasta and Keswick power plants.	Graybar Electric Co	do	[4] 39,795.00
1145	do	Mar. 14	Four 50 by 50-foot regulating gates for installation in the spillway at Keswick Dam.	American Bridge Co	do	217,872.00
1146	Columbia Basin, Washington	Mar. 7	One 12 by 12-foot bulkhead gate for installation at the inlet end of one of the outlet conduits at Grand Coulee Dam.	do	do	7,418.00
1147	Central Valley, Kennett division, California.	Mar. 5	Structural-steel anchorages and gate seats for three drum gates at Shasta Dam.	do	do	[5] 20,341.00
				Schmitt Steel Co	Portland, Oreg	[6] 20,450.00
1148	Central Valley, Friant division, California.	Mar. 6	Construction of 16 miles of Friant-Kern Canal from station 301+60 to station 1144+00 and wasteway at station 298+66.	Betchtel Bros. McCone Co.	San Francisco, Calif	[7] 267,805.00
		Mar. 9		Peter Kiewit Sons Co	Omaha, Nebr	[8] 3,377,605.85
1155	Columbia Basin, Washington	Mar. 16	Radio telephone apparatus for Grand Coulee Dam.	General Electric Co	Denver, Colo	3,895.00
1156	Central Valley, Kennett division, California.	Mar. 30	Four motor-driven gate hoists for operating the 50 by 50-ft. spillway regulating gates at Keswick Dam.	Western Machinery Co	Portland, Oreg	195,910.00
1159	Boise, Payette division, Idaho	Mar. 29	Four vertical-shaft centrifugal pumps and motors for "C" line canal pumping plant.	Washington Pump and Machinery Co.	Harrison, N. J	32,115.00
1160	Central Valley, Kennett division, California.	Mar. 21	Structural-steel for the 230-kilovolt switchyard at Shasta power plant and 230-kilovolt transformer circuits at the Keswick power plant.	Bethlehem Pacific Coast Steel Corp.	San Francisco, Calif	73,257.90
1167	Colorado-Big Thompson, Colorado	Mar. 21	Construction of excavation and concrete lining of Rams Horn and Prospect Mountain tunnels, power canal No. 1.	Lowdermilk Bros	Denver, Colo	1,864,822.00
1174	Deschutes, Oregon	Mar. 9	Construction of four highway crossings, North Unit main canal and laterals.	Sleeper and Keyes	Bend, Oreg	24,718.75
1193	Missouri Basin—Wyoming	Mar. 29	Forty prefabricated, portable and demountable houses for the Boysen Government camp.	Green Lumber Co	Laurel, Miss	105,680.00
1196	do	Mar. 28	Fifteen prefabricated, portable and demountable houses for the Kortes Government camp.	do	do	32,115.00
G-66	Gila, Arizona	Mar. 5	Harvesting, hauling, baling and piling 4,195 tons hay.	W. J. Kamman	Yuma, Ariz	21,526.00

[1] Schedules 1, 3 and 5. [2] Schedules 2 and 4. [3] Schedules 1, 2, and 4. [4] Schedule 3. [5] Item 1. [6] Items 2 and 3. [7] Schedule 1. [8] Schedules 2 and 3.

U. S. GOVERNMENT PRINTING OFFICE: 1946—688772

OUR HONORED DEAD

The employees of the Bureau of Reclamation who gave their lives that we might live in peace, free to pursue its ways, and fulfill the promise of democracy.

Name	*Former Headquarters*
AGUIRRE, FRANK T.	Rio Grande Project, El Paso, Tex.
BELL, LEWIS M.	Denver Office, Denver, Colo.
BISSETT, HOWARD M.	Boulder Canyon Project, Boulder City, Nev.
BINGHAM, THOMAS B.	Columbia Basin, Coulee Dam, Wash.
BOWLING, EVERETT	Deschutes, Bend, Oreg.
BRAHTZ, JOHN H. A.	Denver Office, Denver, Colo.
BROUGH, DAVID A.	Denver Office, Denver, Colo.
BROUGHTON, TILFORD	Deschutes, Bend, Oreg.
BRUCE, C. KEITH	Central Valley, Friant, Calif.
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BUTLER, PAUL P.	Denver Office, Denver, Colo.
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GLAWE, W. W.	Buford-Trenton, Williston, N. Dak.
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HARDY, JAMES H.	All-American Canal, Yuma, Ariz.
HITT, JACK H.	Altus Project, Altus, Okla.
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HUDSON, WILLIAM B.	Boulder Canyon Project, Boulder City, Nev.
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KERSHNER, D. N.	Denver Office, Denver, Colo.
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McGREGGOR, JOHN R.	Mancos Project, Mancos, Colo.
NEWBOLD, THOMAS B.	Project Planning, Durango, Colo.
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ROSS, LEONARD V.	Project Planning, Cheyenne, Wyo.
SCHOUTEN, AREND	Boulder Canyon Project, Boulder City, Nev.
SUNDLING, HAROLD F.	Buffalo Rapids, Terry, Mont.
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WERNER, WILLIAM A.	Pine River, Bayfield, Colo.
WHALEY, HANSEL R.	Central Valley, Sacramento, Calif.
WINN, JOSEPH P.	Boise, Idaho

**Missing in action.*

SPRINGTIME WATERFALLS
in the Grand Coulee

Bureau of Reclamation Photo

JUNE 1946

This Issue Features:

THE CHAIRMAN *Cautions*

by Representative Jed Johnson

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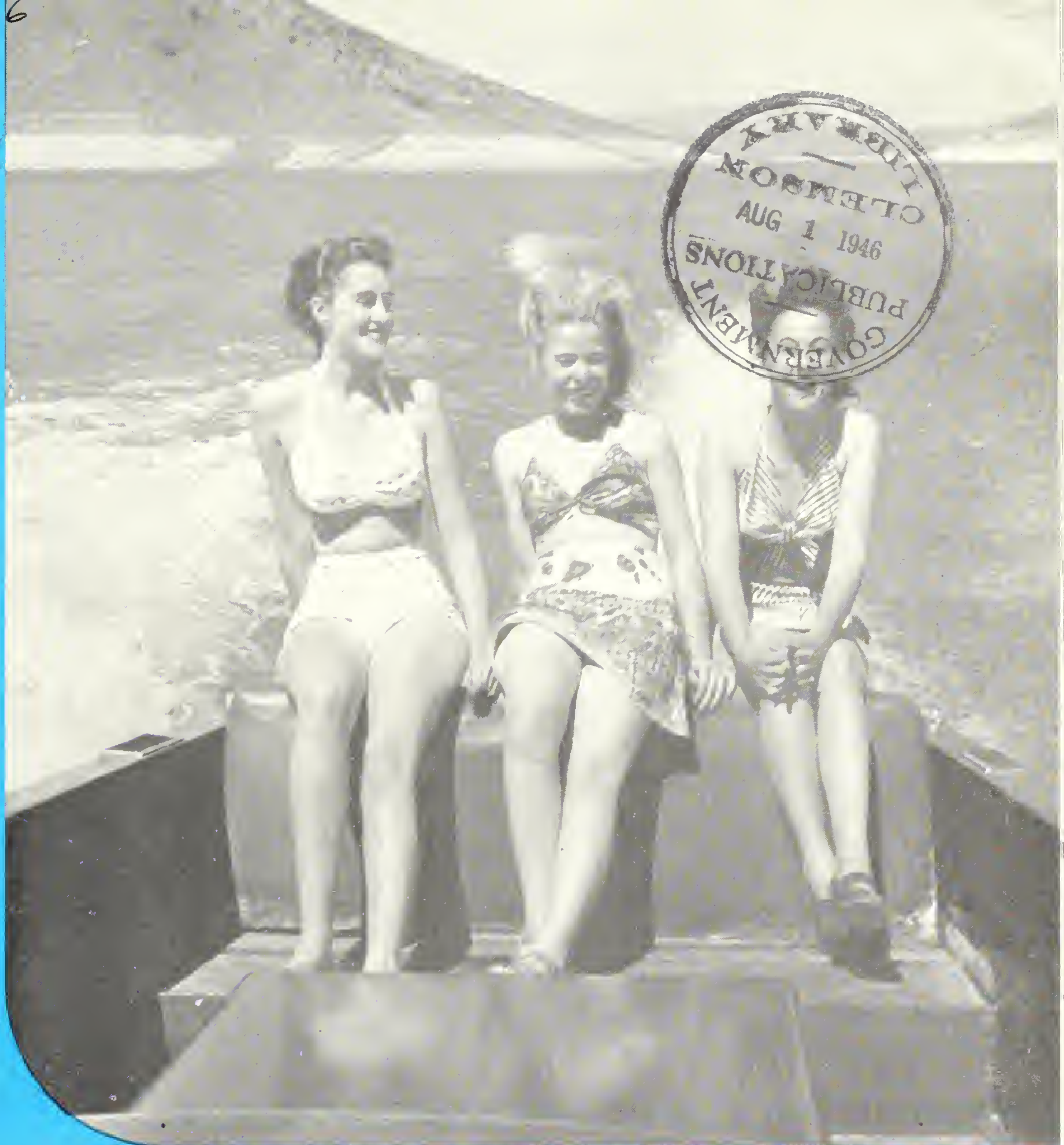
HOLIDAYS AHEAD

★

THE WAR AGAINST WEEDS

★

HOW TO SIDETRACK A RIVER



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Contents

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Lest We Forget

"Our own objectives are clear; the objective of smashing the militarism imposed by war lords upon the enslaved peoples—the objective of liberating the subjugated nations—the objective of establishing and securing . . . FREEDOM FROM WANT . . . everywhere in the world."

Franklin D Roosevelt

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THE WAR AGAINST WEEDS

by **ROBERT B. BALCOM** *

Armed with new war-developed weapons as well as skills and time-tested methods acquired in nearly a half century of irrigation experience, the Bureau of Reclamation is launching an all-out assault on weeds in every Reclamation area in the West.

Common and harmful weeds hit the farm harder than all animal and plant diseases, insects, predatory animals, and rodents combined. Before the war, weeds cost the average farmer about $450 a year. With control work cut down during the war, weeds gained much ground, and today they take an even larger slice of farm income.

Combined Operations Planned

Now the Bureau of Reclamation in cooperation with agencies of the Department of Agriculture, local weed districts and project settlers, is set to blast weeds from their firm footholds in farmers' crop-lands and on ditch and canal banks. Mechanical, cultural, chemical, and burning methods are slated for use in the broad-front attack.

Flame-throwers that burned out caves on Saipan and Okinawa, heavy tanks fresh from European battlegrounds, and amphibian tractors that carried soldiers and marines into Pacific invasional beaches, are scheduled for test in this intensified weed warfare.

Control of weeds only recently has received major attention. It was not considered economically feasible to combat them on a large scale. Back-breaking weed-fighting was left to the individual farmer to carry on as best he could without organized help or scientific advice. The weeds grew and you endured them. That you couldn't cure them was taken for granted.

With the coming of war, calling for huge production and at the same time siphoning off farm labor needed to man the hoe, the great production loss from weeds was recognized nationally. Now scientific weed control research is being undertaken on a large scale and is being prosecuted both by Government agencies and private firms. Although 2, 4-D is not the wonder-working cure-all it was hoped to be, it does have a place in weed control. Its discovery has opened the way for development of other chemicals of great promise and has greatly stimulated research.

Irrigated farms play host to more varieties of weeds than nonirrigated farms. Irrigated fields are perfect weed beds. There are no dry periods to bring on a dormant state. Like most other crops, weeds produce heavier seed yields under irrigation. Conditions are ideal for germination of seed and for spread of the plants from roots and underground stems. Irrigation channels carry the seeds and deposit them on the fields with the water.

Enemies Abound

Weeds common to the East and Middle West were brought in by settlers in the early days of irrigation along with crop seeds from the farms they left. The new weeds found a favorable environment in the newly-irrigated western fields.

The most prevalent noxious weeds include European wild morning-glory or field bindweed, Russian knapweed, leafy spurge, silver-leaved poverty weed, mouse-eared poverty weed, nut grass, perennial sow thistle, quack grass, and white top, known also as white seed, hoary cress or perennial

OLD METHODS OF WARFARE—*Tractors dragging a long ship-anchor chain through a weed-choked ditch to break them loose from their strangle hold. After the weeds are torn from their moorings and float to the surface, they are caught at conveniently-placed racks and forked to the bank. (See picture at top of page.)*

*Agronomist, Branch of Operation and Maintenance.

The Enemy . . .

CLOGGING A DRAIN—*Parrot feather and cat-tails impeding the progress of the drainage system, and causing water-logged irrigation lands.*

pepper grass. Peculiar to the South are camel thorn, blueweed, white horse nettle, and Johnson grass.

The common weeds not ordinarily considered noxious but which increase production costs include pigweeds, milkweeds, mallows, mustards, dodder, Russian thistle, bassia, kochia, foxtails, squirrel tail, and wild oats.

The high cost of weeds shows up in every farm operation from preparing the seed bed to harvesting the crop. To retard the weeds, planting may have to be done at the wrong time. Deeper plowing is often necessary. More cultivation is needed. Special equipment, hand tools, and more hand labor are entailed. Need for growing crops that upset the weed cycle makes crop rotation difficult and greatly lowers cash return. Late plowing may entail extra irrigation to keep the crop ahead of the weeds. The matted weed plants cause over-penetration of water in the furrows so that the upper end of the row is soaked while the lower end is too dry. More water is needed to irrigate both the crop and the water-robbing weeds.

Weeds reduce the yields per acre and in some cases take over fields entirely. Poisonous weeds such as whorled milkweed and water hemlock cause serious livestock losses. Cockle bur and burdock and other bur weeds injure wool and pelts. Mouth and skin infections of livestock result from mechanical injury by certain weeds.

The Bureau of Reclamation employs a weed specialist in each of its seven regions. He plans and carries out direct and cooperative control programs in his region.

Prevention Pays

Special emphasis is being placed on prevention of weed plagues on new projects. A weed survey, for example, has already been conducted on the million-acre Columbia Basis project. Thus, with the existing weed problem known, an effective control program may be mapped ahead of settlement. Existing weeds left uncontrolled are a source of infestation for the entire project. Prevention methods loom large in the educational program for new project farmers.

Two separate phases of weed control exist on irrigation projects. Crop-land weeds are one side of the problem and ditch-bank and water weeds the other. The Bureau of Reclamation does not engage directly in crop-land weed prevention and eradication. Spurred by an acute interest in the agricultural welfare of project farmers and by need to safeguard the heavy Government investment, the Bureau cooperates with agencies of the Department of Agriculture, with State

. . . At Its Worst

CHOKING A DITCH—*Cattails, sedges, and grasses growing in silt deposits in concrete-lined ditches, causing them to deteriorate and holding back irrigation water.*

college experiment stations, local weed committees, and other interested agencies by providing color sound films, slide and strip-film lectures, conducting weed tours, and by advice at farm meetings on weed control and prevention.

Weeds Grow Everywhere

Ditch-bank land weed and channel water weeds seriously affect operation and maintenance of the projects and are a direct responsibility of the Bureau of Reclamation. Ditch-bank weeds not only include noxious and common cropland weeds, but also species of willows and tamarisk, giant reed grass often called cane or bamboo, water grasses, water hemlock, and sedges.

(Continued on p. 119)

NEW METHODS OF CHEMICAL WARFARE

The gadget at left uses pressure to spray chlorinated hydrocarbon through the nozzles of the pipe spray directly to the stream for water weed control. At right, the milkywhite chemical is infiltrating into the enemy's territory. Within a few hours the weeds will disintegrate and sink to the bottom of the channel.

Commissioner's Column

by MICHAEL W. STRAUS, *Commissioner*

Commissioner Straus

Many an irrigation farmer who is kept pretty close to and busy in his fields and orchards these late spring days will be interested to learn that American irrigation engineering is commanding increasing world attention. This is happening despite the fact that irrigation is almost as old as agriculture itself and that several other countries irrigate far more land than we do.

The fact is that since the war, engineers are coming from almost every part of the globe where rainfall is scarce, to learn how we do our irrigating. Last year Bureau of Reclamation offices were visited by more than 500 foreigners and Government representatives in connection with foreign activities. Most of the visitors were engineers who wanted to learn how we build our dams and distribute irrigation water, in order that they might return to their homes and do likewise. And their homes were in Africa, Australia, Canada, South America, England, France, Greece, India, Russia, China, Afghanistan, and quite a few other places. In 1945 more than twice the number of foreign visitors looked us over than in the previous 10 years.

One reason for this sudden interest lies in the tremendous importance, brought home by the war, of resource development of every kind. Every alert nation now knows that it must make the most of its natural resources—knows that great as these resources are, population is continuing to increase while many resources diminish—knows that its strength lies in its developed resources.

Now it seems as though the world has discovered something we knew all along—that our Bureau of Reclamation engineers know how to build big dams like Boulder and Grand Coulee better than anyone else. When a foreign government starts to look around for the best talent in big dam building, it almost inevitably lands right smack in the offices of the Bureau. Last year 25 engineers from China were sent to our projects for an "on location" course in American reclamation methods. And some of our own engineers are today abroad making studies for the resource development of counties blasted by war or agelong exploitation.

The Yangtze Dam project that the Bureau of Reclamation is designing for China and which commands such wide attention, is merely the symbol of similar demands made on Bureau engineers from many lands. Thus, American irrigation farmers have a link with the rest of the world—a form of cultural relations that is new and most effective.

But despite the world recognition that the western irrigationist and the engineers are winning, the American reclamation program remains just that, and will not be distorted into a world diplomatic instrument. To insure that the Bureau of Reclamation gives first attention to its own western work, three hard policies have been adopted and enforced. The first is that the Bureau deals with foreigners only at the request and with the approval of the Secretary of State. The second is that no funds appropriated by the Congress for American irrigation be used to pay engineers making foreign surveys and that any such funds be provided in advance by the foreign governments concerned. And the third is that no matter what the foreigners request, the State Department approves, and distant lands finance, priority must at all times be given to our western development program.

But, nevertheless, the American irrigationist and the Bureau of Reclamation may take some satisfaction in the recognition they have won and the fact that the rest of the world is seeking to pattern its efforts on American performance.

War Against Weeds

(*Continued from p. 118*)

Ditch-bank weeds cause ditch stoppages and overflows, ditchbreaks, seepage, and reduction of carrying capacity, and render inspection of ditch and canal banks and structures difficult if not impossible. Seeds from the weeds also are carried on by the water and are a source of infestation for the irrigated fields served by the ditch.

Water weeds growing in the channels cause the most serious and vexing problems in irrigation weed control. These include water lettuce, water hyacinth, tules, cattails, parrot-feather, water primrose, watercress, pondweeds, horned pondweed, coontail, milfoils, muskgrass or stonewart, water star grass, spiny naiad, waterweed and algae.

Water weeds in general cause stoppage of channels and drains, reduce capacity, prevent flow regulation. They cause silt accumulations, seepage, and waste of water.

A manual on ditch-bank and water weeds is being prepared by the Bureau of Reclamation. It is expected to be available for distribution by late spring or summer.

The Bureau of Reclamation weed control program includes (1) survey and analysis of the weed problem and determination of control costs, (2) selection of best control methods for immediate problems—chemical, mechanical, mowing, burning, etc., (3) plan of prevention campaign, (4) improvement of control methods by conducting tests and applying research findings, and (5) cooperation in educational and other weed programs.

Technicolor Film Available

If your organization needs a film on weed control for one of its meetings, prints of "Fighting Weeds" may be obtained by writing to the Regional Director, Bureau of Reclamation, of the region where the group is located, and paying mailing charges both ways. Those in areas other than the irrigated West should direct their request to the Commissioner, Bureau of Reclamation, Washington 25, D. C.

This new Bureau of Reclamation release is a 16-millimeter sound film in technicolor and has a running time of about 38 minutes.

The film shows how the farmer's income is affected by noxious weeds, how weeds get started on farms, and how to prevent weed infestations. It also depicts the importance of identifying weeds and of effecting early control, as well as some of the standard weed control methods. The value of organized weed control such as may be obtained through the formation of weed districts is shown. The film is based primarily on weed control under irrigation farming conditions.

The CHAIRMAN *Cautions*

by The Honorable JED JOHNSON,

Representative from Oklahoma and Head of the House Subcommittee on Interior Department Appropriations

The Hon. Jed Johnson

Long before I became Chairman of the Interior Department Subcommittee on Appropriations I became deeply interested in the subject of reclamation. It was on the occasion of the dedication of Boulder Dam that I saw first hand the need for conserving water in our great Western States. It will be recalled that the late President Franklin D. Roosevelt went by special train from Washington to Boulder Dam. It was my good fortune to be invited to ride with President Roosevelt on his train. I found him to be enthusiastic about reclamation. He also talked considerably about reforestation and the conservation in general of our natural resources.

After the Boulder Dam dedication I left the train and visited through several Western States with another devoted friend who has passed to his reward, the late Senator James G. Scrugham, who at that time was a colleague in the House. We visited several other projects and proposed projects. The late Senator was a super-salesman. As we drove entirely through the State of Nevada it was dry, hot, and dusty, but every once in a while one could see a green spot in what seemed to be a crevice in the mountain side and often times we would visit those green spots. Of course, water was the answer, and in many instances there were small irrigation projects.

We also visited a number of natural and man-made lakes, and my colleague would remind me that the water level was gradually sinking year by year. Since that time I have visited every State west of the Mississippi River and personally have seen a vast majority of the leading Reclamation projects.

Another of my early teachers on reclamation was the late Congressman Edward T. Taylor of Colorado, former Chairman of the House Committee on Appropriations. Chairman Taylor was the greatest water conservation enthusiast I have ever known, and he did not hesitate in his endeavors to sell his ideas on what he freely admitted was his pet hobby to members of his Committee as well as all others who would listen to him. "Water to the great West is what the blood streams are to the body," he often said. It is needless to add that I have long been sold on the absolute necessity of conserving that precious "commodity" called water for the thirsty West.

But being sold on reclamation and being able to make all the funds available that all of the many projects really need is entirely a different matter. If there is anyone who thinks that my job as Chairman of the Interior Department Subcommittee of the House Appropriations Committee is an easy one, he ought to have the unhappy privilege of enduring it for a year or two.

The Department of the Interior deals largely with development of the West. Westerners are not shy or shrinking when it comes to requesting funds from the Congress. Each year during our long hearings we hear many witnesses, and almost invariably the request from every witness is for more funds than are sent to us for the respective project or agency in which the witness is especially interested. If the Subcommittee of which I am Chairman were to grant all of the requests from Congressmen and others, the taxpayers would think we were trying to finance another war. But to trim requests for funds to a figure the Nation can afford, without stirring up every kind of two-legged and two-fisted animal that stalks the plains, is a job for King Solomon himself—and he died a long time ago.

So our Committee has as its task the most unpopular thing that any group of Congressmen can do—turning down the requests of good neighbors and friends who come asking for what they consider a "very modest" fund for the "best" project in all the U. S. A. The difficulty lies in the fact that there are so many "best projects" that Congress cannot satisfy them all at once.

Further Study Urged

Now there is no man in the Congress to whom I will yield when it comes to an honest appreciation of what the Bureau of Reclamation has done to develop the West, and I have not hesitated to say so publicly and privately on many occasions. The engineers who built Boulder and Grand Coulee and Shasta Dams—and dozens of others—are, in my book, among the greatest engineers in the world. Moreover, the living wealth they have created from our natural resources will continue to yield satisfactions for generation after generation of Americans.

All of us know that the power produced at these dams was vital in the war production of ships, tanks, guns, and other munitions, and therefore was an important factor in preserving these dams to futur[e] Americans. Had it not been for this hydro[-]electric power, and for the industrial work[-]ers who used it and for the men who use[d] the weapons this power forged, these dam[s] might today be in the hands of an enem[y] alien race. But that is water over the dam[,] or, at least, we hope so.

Let us indulge in the hope that we ar[e] building not for future wars, but for a peopl[e] dedicated to peace. The new wealth yet t[o] be created by the Bureau of Reclamatio[n] will give us the strength with which to hel[p] win and, we hope, to preserve the peac[e]. Remembering past history, however, w[e] must be ready for any emergency. But I d[o] not share the view of some that this build[-]ing must be accomplished at a frenzie[d] tempo. We have not yet thoroughly though[t] through all of the problems that face us i[n] planning a coordinated development of th[e] resources of our Western river basins.

For instance, we have not given nearl[y] enough attention to the problem of pre[-]venting siltation of the great reservoirs w[e] are creating behind our dams. The eng[i-]neers can tell you how to build the dams[,] but they are not as smart in telling you how to terrace the slopes and hillsides or to re[-]forest our mountainsides, so that erosio[n] will be lessened. They do not emphasiz[e] the great need for reclaiming our grazin[g] lands that have been overgrazed so badl[y] that their soil is washed into the rivers an[d] fills the reservoirs.

Here is a field in which the Departmen[t] of the Interior must develop a lot mor[e] teamwork and approach its problem wit[h] much better developed plans, before i[t] builds too many reservoirs. If it does no[t] some of the reservoirs being built now wi[ll] be filled up almost before the last in th[e] program now contemplated is finished.

I have been talking about this phase o[f] the Reclamation program for many years[.] The matter of erosion is not only a seriou[s]

(Continued on p. 125)

Holidays Ahead

by OSCAR J. BUTTEDAHL*

WATER FLIER—*Water sports are back! The end of the war meant that Reclamation's man-made lakes again would be available to sportsmen in the West. Perhaps few of us ever will attain this championship form of Jack Burrud, the "Sun Valley Bronco" shown in prewar days as he established an official world's record for aquaplanes on Lake Mead, but the chance to try again is ours.*

You no longer will have to dream about that cruise you'd like to take. Neither will you have to board an ocean liner.

Try the waterways of the West.

One of the cruises which warbound motorboat men of the Pacific Northwest have dreamed about now can become reality—the spectacular 360-mile run up the gorge of the Columbia River from Grand Coulee Dam to the head of the Arrow Lakes in Canada.

Only a few had an opportunity to make this trip before their boats were put away for the "duration," but those who did still speak of it in glowing terms as a thrill-packed adventure that will test the mettle of the most skillful navigator. Nearly half the voyage will be through the reservoir created by the building of Grand Coulee Dam which backs up the Columbia a distance of 151 miles. The reservoir covers 82,000 acres, and it is planned to develop the region surrounding it into one of the finest recreational areas in the Nation.

In fact, these man-made lakes created behind the concrete walls of Government dams will help to make the West more than ever "the playground of America" by placing within easy reach of thousands of people the facilities for rest and recreation. Western States are dotted with such artificial lakes. Most of them came into being as the result of dams built by the Bureau of Reclamation of the Department of the Interior. The largest and best known of these dams are Grand Coulee, Boulder, and Shasta, but many smaller ones have been constructed by the Bureau in developing western water resources.

Recreation Incidental

The Government, of course, didn't build these dams for fun. The recreational opportunities they afford are only incidental to the larger purposes they serve. Boulder, for example, has the largest hydroelectric power plant in the world. Grand Coulee, when the Columbia Basin project is completed, will supply the water for irrigating more than 1,000,000 acres of land. These dams provide the water supplies for towns and cities; tame rivers to prevent floods or reduce flood damage; regulate river flow to improve navigation; and provide havens of refuge for waterfowl and other wildlife.

These lakes, and the area surrounding them, also have been developed for recreational purposes, and some of them before the war attracted thousands of visitors annually. The facilities at each vary, but whether you want to take the family for a picnic dinner in the park or go camping out along the river, accommodations usually can be provided. Water sports are always an attraction. Motorboat races are an annual event and facilities also are provided for other types of boating. Beaches have been built for swimmers, young and old. The lakes are stocked with fish to tempt devotees of the rod and reel. Park and playgrounds offer opportunities for rest and relaxation.

Recreation areas resulting from the construction of these multiple-purpose dams by the Bureau of Reclamation are found in an area which extends from the Canadian border to Mexico, from the eastern slopes of the Rockies to the Pacific. In the Northwest, Franklin D. Roosevelt Lake behind Grand Coulee is the largest of these man-made lakes and has the greatest possibilities for development. The Bureau maintains a large boat dock at the dam and has completed marine ways. A barge formerly used as a floating camp for workers was turned over to the Grand Coulee Yacht Club for a clubhouse. An extensive program for development of recreation facilities is planned, including construction of the Coulee Dam marina, the establishment of several parks, lakeside camps for fishermen, and overnight stopping places for boats.

In central Washington on the Yakima project built by the Bureau there are six reservoirs in the Cascade Mountains where boating, fishing, swimming, and camping are attractions. These include the Kachess Reservoir, 12 miles long, Lake Cle Elum, and the Tieton Reservoir.

Motorboat Regattas Held

Second largest of Bureau reservoirs in the Pacific Northwest is located near American Falls, Idaho. It is 25 miles long, has a surface area of 56,055 acres, and offers excellent opportunities for water sports of all kinds. Near Nampa, Idaho, is Deer Flat Reservoir, famed for bass and perch fishing and its motorboat regattas. At Black Canyon Reservoir near Emmett, Idaho, boat racing is a popular diversion. Located 60 air-line miles north of Boise is Deadwood Reservoir, a mecca for summer vacationists. On the Snake River near Burley in southern Idaho is Lake Walcott, a wildlife refuge.

Oregon also has many recreational areas developed around the artificial lakes created by Bureau dams. South of Nyssa is the 52-mile long reservoir behind Owyhee Dam, with facilities for all kinds of water sports, a floating dock for boatmen, and excellent fishing for crappies, bass, and perch. Other Oregon recreation spots include Agency Valley Reservoir on the north fork of the Malheur River near Vale; Cold

*Chief, Press and Radio Section Information Division.

THIS IS NO "FISH STORY"—*Hollywood actors can vouch for the fact that the reports of big bass in Lake Mead are not the usual fish stories. Collin Topley, John Howard, and Fred MacMurray, all from Hollywood, and their guide, shown here from left to right, are quite happy about it all.*

Springs Reservoir near Umatilla; and Unity Reservoir near Hermiston.

Californians have two immense artificial lakes behind Shasta and Friant Dams on the Bureau's Central Valley project. Located 12 miles north of Redding in a setting of red foothills and white-topped mountains, Shasta Lake covers a surface area of 30,000 acres and its rugged shoreline traverses 365 miles of picturesque California scenery. The lake is formed by the waters of three rivers which rise in heavily-wooded slopes of the Siskiyou and Cascade Ranges. Boatmen may travel at least 25 miles up the canyons of each of these rivers to mountain retreats unexcelled for fishing and hunting. Extensive development of the reservoir and dam site area for recreational purposes is planned.

Camping Facilities Near Friant

Some 350 miles south of Shasta, where the San Joaquin River emerges from the foothills of the Sierra Nevadas, Friant Dam spans the river to create Millerton Lake. It covers 5,000 acres, and has a 45-mile shoreline that varies from gentle slopes near the dam site to steep canyon walls farther inland. Unhampered by seasonal limitations of high-altitude areas, Millerton Lake's season may extend over 8 or 9 months, with camping, riding, and hiking possible the year round. It is but a half hour's drive from Fresno and Madera, and a survey made by the Fresno Motorboat Association in cooperation with the Bureau of Reclamation indicated that as many as 500 motorboats may be operated on the lake when facilities are completed.

The Bureau is planning to open both Shasta and Millerton Lakes for more extensive recreational use as soon as conditions permit. A study of the possibilities for such development has been made by a committee representing 20 Federal, State, and local agencies. The committee has recommended that the Shasta Reservoir be developed as a resort area with sites for lodges, cabins, and docks granted to private parties under lease or permit, and that Millerton Lake be developed as a publicly-operated park or recreational area, because its nearness to population centers will make it less necessary to provide housing accommodations.

Bureau of Reclamation "lake makers" have also been active in the central Rocky Mountain region in developing recreational areas for the enjoyment of those who live in the area and for tourists and vacationists. Residents of Ogden, Utah, after closing up shops and offices on Saturday nights, head for Pine View Reservoir in the picturesque Wasatch Mountains just 7 miles away. Regattas, held twice a year before the war, were sponsored by the Ogden Pine View Yacht Club, and attracted as many as 3,000 spectators to watch up to 30 speedboats in action. Camp Browning on the shores of the reservoir is widely known as a Boy Scout summer camp.

Largest Bureau development in Utah Deer Creek Reservoir in the canyon of t Provo River, a short distance from Sa Lake City and Provo. Completed 4 yea ago, the reservoir is well stocked wi rainbow, German brown, and native trou and the largest fish hatchery in the State located at its upper end. When full, t reservoir stretches 6 miles up the canyo ranges in width from one-half to thre fourths of a mile.

Other popular Utah recreation cent include Strawberry Reservoir in the nor central part of the State where more th 300 private boats were operated in 19 and the opening of the fishing season tracted 5,000 anglers. Scofield Reserv on the Price River will be enlarged to water surface of more than 2,800 ac when construction of a higher dam is co pleted. Motorboat racing has become major summer sport, and 4 and 5-pou rainbow and native trout challenge t fisherman's skill. Hyrum Reservoir on t Little Bear River and Moon Lake in t Uinta Basin also offer facilities for bo ing, fishing, swimming, and other outdo sports.

In the scenic mountains of northe Colorado, a Bureau of Reclamation da on the Blue River has created Green Mou tain Reservoir, nearly 1½ miles wide a 8 miles long. Set in gem-like beauty an forest-clad slopes, the reservoir abounds game fish and offers ideal conditions boating and swimming. Nearing comp

Our Front Cover

ELEPHANT BUTTE LAKE, ***in Sier County, N. Mex., is one of the ma spots where man has aided nature providing an ideal playground a restful haven for vacationists. Ca line Sherwin, Lilly Carbajal, a Connie Miller (pictured left to righ are among those who have fou recreational opportunities to be valuable byproducts of Reclamati projects.***

tion in the heart of the Rockies at an elevation of more than 8,000 feet is Shadow Mountain Dam which will create a lake covering about 1,200 acres. It will be connected to Grand Lake by a narrow strait to offer one of the finest recreational areas in the United States.

High in the San Juan mountains of southwestern Colorado is located one of the most beautiful lakes in all the West—the Vallecito Reservoir at an elevation of 7,650 feet. It was completed in 1941, is well stocked with rainbow and brook trout, and the heavily-timbered hills surrounding the lake are inhabited by many kinds of wildlife, including deer, elk, bear, and wild turkeys. More than 200 boats have been licensed to operate on the reservoir in a single season.

Taylor Park Reservoir in the Gunnison River area to the north is another well known Colorado recreation area, far-famed as a fisherman's paradise and playground for summer vacationists.

Water Sports in Wyoming

In Wyoming, Bureau dams on the North Platte River in the southern part of the State have created four large bodies of water to make possible the development of the areas for recreational use. Pathfinder Reservoir, 17 miles long, and Alcova Reservoir, somewhat smaller, are within easy motoring distance of Casper. Seventy miles to the southeast is the Seminoe Reservoir, 22 miles long, and near the Nebraska boundary is Guernsey Reservoir, 12 miles long and 2 miles wide at its broadest point. All four provide facilities for water sports, picnics, and outings. The Jackson Hole country in northwestern Wyoming is justly famed as an outdoor playground, and Lake Jackson, created by another Bureau dam, is an ideal vacation spot. Not far away is Shoshone Dam, recently renamed Buffalo Bill Dam. Located in a scenic box canyon of the Shoshone River near Cody, Wyo., it creates a lake of great beauty near the eastern entrance to Yellowstone National Park. Two other smaller reservoirs in central Wyoming, Pilot Butte and Bull Lake, provide recreational opportunity principally for local residents.

Bureau engineers have harnessed rivers in the plains country of Montana to store water for irrigation, and the reservoirs created are also widely used for recreation. The Gibson Reservoir in rugged Sun River Canyon 80 miles west of Great Falls, affords excellent fishing and the area is popular with hunters and others who seek solitude and the joys of "roughing it." Sherburne Reservoir is located in Glacier National Park and is noted for its pike and trout fishing. On the Milk River project in northwestern Montana near Havre is the Fresno Reservoir with a shoreline of 25 miles. Boating is a popular pastime and frequent regattas are held. The Nelson Reservoir is located 20 miles east of Malta near a major flight-lane for migratory waterfowl, and hunting is a popular sport. The reservoir has also been stocked with fish and has excellent facilities for boating and swimming.

But nowhere is there greater appreciation of the value of water and its beneficial uses than among the people of the great Southwest. Every gallon is precious. And every lake is a utopia—on the desert. The feelings of the people of the Southwest can therefore readily be imagined when they saw spread out before their eyes a lake 230 square miles in area where none had been before. This was the miracle accomplished under direction of Bureau of Reclamation engineers in the building of Boulder Dam in the Black Canyon of the Colorado River on the boundary between Arizona and Nevada. The dam backed up the river to form Lake Mead which supplies water for irrigating more than 600,000 acres of land and for generating much of the power that turned the wheels of California war industries.

Lake Mead, with a shoreline of 550 miles, extends 115 miles up the river, varies in width from a few hundred feet in the canyons to 8 miles in plateau areas. It is one of the principal recreational centers of the Southwest, and the dam itself is a major attraction to tourists, with visitors in 1941 numbering 840,000. Upward of 250 boats operated on Lake Mead before the war.

On the California-Arizona border about 125 miles below Boulder Dam is Lake Havasu, created by the building of Parker Dam. Fifty miles long and up to a mile in width, the lake offers excellent fishing for bass, perch, blue-gill, catfish, and crappie.

Texas cowboys too are going in for motorboating and some of them are as much at home on a plunging speedboat as they are on the back of a broncho. It is a common sight on highways of the Lone Star State, New Mexico, and Oklahoma to see automobiles with boats mounted on trailers, headed for some lake or river. This region is part of "the land of little water," and since lakes are not so numerous as in other areas, they are appreciated all the more.

Altogether, the dam-building activities of the Bureau of Reclamation on Western rivers has created a total of 89 man-made lakes and reservoirs, most of them developed for recreational use along with the primary purpose they serve of storing water for irrigation. Others are in process of construction and many more are scheduled to be built in the years to come.

So we are harnessing our rivers for work—and for play. Not only to help us grow our crops and drive our machines, but to bring us pleasure and happiness in the facilities they provide for healthful outdoor rest and recreation.

GO WEST FOR THAT VACATION!—*This is among the reasons that Horace Greeley well might have had in mind when he advised young men to go West. We refer, of course, to a cruise such as this on beautiful Lake Mead. With gasoline rationing a thing of the past, Reclamation's man-made lakes again are available to boating enthusiasts.*

How to Sidetrack a River

Diversion Channel Solves Davis Dam Problem

by JOHN A. LEVERITT *

What is to be done with a river while a dam is under construction? That ever present problem of dam designers and builders was once more posed by Davis Dam, which is being constructed in Pyramid Canyon by the Bureau of Reclamation on the Colorado River 67 miles below Boulder Dam.

"Diverting the flow of the river during the construction period is one of the major problems which influence the location, design, and construction methods of a dam," says E. A. Moritz, Director of the Bureau of Reclamation's region III office at Boulder City, Nev.

To put the matter simply, the river must be sent through or around the dam while it is under construction. During the history of dam building, engineers have evolved countless ingenious applications of these methods. The terrain surrounding the site, the rate of flow of the river, and many other factors contribute to the problem.

At Boulder Dam, four 50-foot tunnels around the dam site were drilled in the solid rock walls of Black Canyon. At Grand Coulee, the Columbia River flowed over some sections while work was done on other sections. Streams have been permitted to flow through temporary conduits or permanent discharge outlets at many dams, such as Roosevelt in central Arizona.

Diversion Channel First

The question was settled in the case of Davis, largest project on the Colorado River since construction of Boulder Dam, by planning to have the river diverted around the dam in a channel on the Arizona side of the river. Therefore, the initial phase of the construction program by the Utah Construction Co., contractor on the dam, will be the excavation of the diversion channel.

Engineers of the Bureau of Reclamation designed Davis Dam so that this diversion channel would become a permanent feature of the dam and its appurtenant works. The 4,500-foot channel will have a bottom width of 200 feet at the upstream or diversion portion. The forebay portion of the channel will have a bottom width of 75 feet widening at the downstream end to accommodate the forebay structures and spillway.

The sides of the forebay channel, for 1,070 feet upstream from the forebay structure, will be concrete-lined. The spillway and outlet structure at the end of the forebay channel also will be of concrete. The power water intake at the right side of the downstream end of the forebay channel will be a massive concrete structure enclosing five 22-foot welded plate steel penstocks leading to the power plant. The power plant will have five outdoor-type generators. This type of generator will extend above the roof of the power plant substructure.

Cofferdams Planned

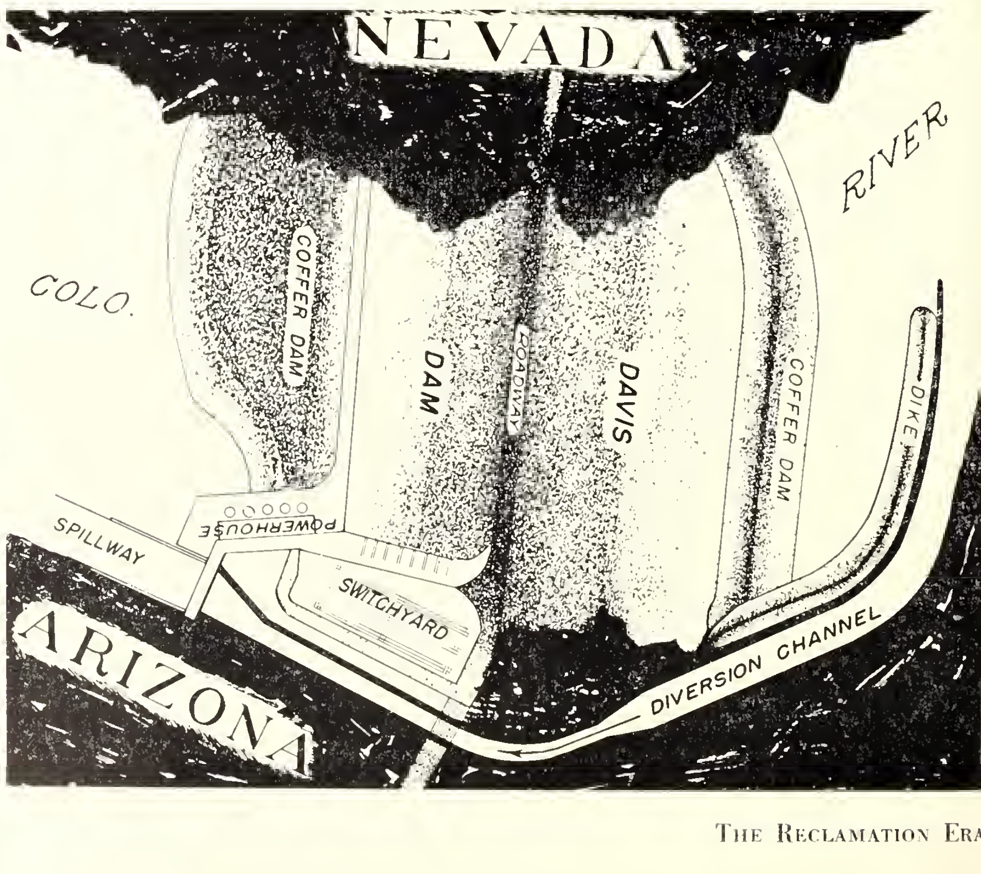
Before cofferdams can be placed across the river above and below the site of the earth and rock-fill barrier, the channel will have to be completely excavated and considerable work done on the forebay channel, the intake structure, and the spillway. A cofferdam is a temporary dam, so-called because it creates a coffer or space fro[m] which the water is excluded.

Excavation for the channel will amou[nt] to approximately 3,000,000 cubic yard[s,] much of which will have to be blaste[d] through solid rock. Hills towering mor[e] than 200 feet above the required level of th[e] channel will have to be cut down.

Concrete in the forebay channel, the in[-]take structure, and the spillway from a[n] elevation of about 500 to 550 feet will hav[e] to be placed before the river is diverte[d.] This will amount to approximately 150,00[0] cubic yards.

Water must be released continually a[t] Boulder Dam for power production, an[d] this water must be allowed to flow un[-]hindered past Davis for irrigation an[d] power production farther down the strea[m.] These releases will vary during construc[-]tion. The diversion channel has been de[-]signed to accommodate a maximum flow o[f] 60,000 cubic feet per second, Bureau en[-]gineers say.

Above is a drawing of Davis Dam, showing how the diversion channel will permit the rive[r] to flow around the site of the dam through openings in the spillway.



*Project Information Officer, Davis Dam.

Flood Worry Alleviated

It is early to say when this diversion can take place, but Construction Engineer H. F. Bahmeier, of the Bureau of Reclamation, estimates a year to a year and a half.

Boulder, the massive key to all development of the lower Colorado River, will alleviate at Davis a major worry of dam builders in the West. That worry is floods—flash and seasonal floods. Probably every engineer and construction man who has had any considerable experience in western dam building has spent many an anxious hour watching the water level of a stream that was threatening to go on a rampage. Although all available data on the rate of flow of a river are gathered, unprecedented rains or spring run-offs can upset plans. For instance, a good deal of construction on the Roosevelt Dam, one of the first projects under the Reclamation Act of 1902, was wiped out in November of 1905 when a high flood with an estimated peak discharge of 130,000 second-feet came tearing down the Salt River. Diversion methods then were altered and the dam completed in 1911.

Even if large run-offs occur in the Colorado River above Davis Dam during the 3- to 4-year construction period, they will be regulated by storage in Lake Mead above Boulder Dam.

After the river has been diverted, work on the dam itself can proceed. Cofferdams will be thrown across the river above and below the dam site so that the section where the dam will be constructed can be pumped dry. The river bed then will be excavated to give the dam a sound foundation, and placing of the embankment will begin.

More Facts About Davis

The Davis Dam project was named in honor of the late Arthur Powell Davis, director of the old Reclamation Service (now Bureau of Reclamation) from 1914 to 1923, and one of those who laid the foundation for the development of the Colorado River.

It is estimated that the Davis Dam project will cost in the neighborhood of \$77,000,000 at 1945 prices. Construction of the dam, power plant, spillway, and other appurtenant works will require approximately \$46,000,000 and the transmission lines and substations to utilize the power will cost approximately \$31,000,000.

Davis Dam will be an earth and rockfill barrier rising 138 feet above the river bed, and will create a reservoir with a capacity of almost 2,000,000 acre-feet, extending to the tailrace of the Boulder Dam power plant. The dam will be 1,600 feet long with a crest 50 feet wide to accommodate a two-lane highway 44 feet wide.

Almost 4,000,000 cubic yards of earth and rockfill will be required to form the dam and about 455,000 cubic yards of concrete and 15,000,000 pounds of steel reinforcing bars will go into the forebay, spillway, and power plant structures.

Davis Dam is being built to effect a greater degree of conservation of Colorado River water. The dam will service provisions of the recently approved Mexican treaty for the division of the waters of the Colorado, Rio Grande, and Tiajuana Rivers; it will produce power, regulate the flow of the river and also serve other purposes such as providing a recreation area.

The CHAIRMAN *Cautions*

(Continued from p. 120)

problem in the so-called Reclamation States but it is a serious problem in my own State of Oklahoma and many other States of the Union. I have discussed this phase of the program with my good friend, the able Secretary of Interior, the Honorable J. A. Krug, and I know that he is deeply interested and concerned in this and alert to the urgent need for doing something about it.

I have no desire to enter into an extended discussion of the question of public power. To those who are constantly saying my Committee is "packed" against public power, I would remind them that it has not hesitated to make funds available for power projects during the war, including transmission lines, where it was shown that public power was essential. In fact, my Committee has made funds available for the construction of more than 3,000 miles of transmission lines on one project alone. I refer, of course, to the great Grand Coulee Dam project on the Columbia River. But now, with hundreds of war projects closed down, there are some who apparently think the Committee should make funds available to continue the same high-speed tempo of construction that we had during the war.

It is a well known fact that Secretary Krug favors public power when it can be justified, but the fact remains that he told my Committee that, while he favors the sane development of public power, he also considers power secondary to reclamation—getting the needed water on arid lands. So do I. I voted for the TVA, for the building of Boulder Dam, for the construction of Grand Coulee Dam, and for many other Reclamation projects with power in them. No doubt, I shall vote for other such projects as the need arises. But, without minimizing the importance of power which is, of course, important to get the needed water on arid land, there is a definite feeling with many Members of Congress that the Interior Department has too often placed the cart before the horse in making power the primary purpose of reclamation projects rather than secondary.

I realize full well that there are some who feel that my Committee has been niggardly and downright stingy in the matter of appropriations for the Bureau of Reclamation, but considering the fact that the Bureau of Reclamation had approximately \$135,000,000 unexpended last January when the Committee started holding hearings on the annual appropriation bill for the next fiscal year is our answer. That is the best evidence that our Committee has been rather generous with the Bureau and, judging from my mail, there are plenty of citizens in Oklahoma and other States who feel that the Bureau of Reclamation is going "hog wild" in the matter of expenditure of funds.

I am not asking anyone to turn backward. I have unlimited faith in the future of America as well as the future of reclamation. The projects heretofore constructed have proved to be economically feasible. They have made the country richer, not poorer. That excellent record must not be broken. Without doubt there are many other basinwide projects that are in the same category. But all such worthy projects cannot be constructed this or next year. All proposed new projects must be scrutinized more carefully than ever by the Congress. Perhaps we have borne down somewhat heavily on the funds for planning new projects, but it would seem like good business to finish the present projects before planning too many others for the future.

Our Back Cover

WORK STARTS ON DAVIS DAM.—*Tons of rock and earth rise as construction is officially begun on Davis Dam by the contractor, the Utah Construction Co., on April 19, 1946. The explosion of 12 tons of dynamite, blasted from a hill being cut down to form the diversion channel, was the focal point for an informal ceremony.*

Town on the Move

Robert Lee Faces Third Trek in Search of Water

Moving day holds no terrors for the citizens of Robert Lee, Tex., even when it means the third move within the last 57 years, and includes houses, courthouse, main street, and all.

The town was first christened Hayrick, after a rounded butte nearby, when a group led by admirers of the famous Southern general first settled it in 1889. The next year, in search of life-sustaining water, it moved several miles down to the shores of the Colorado River, and the name was changed to Robert Lee.

Now it is preparing to pick up its buildings and move again, in search of a bigger and better town site, complete with a lake view and possibilities for a future as a resort town serving a broad area of west Texas.

Citizens Welcome Inundation

This unusual willingness to undertake such a difficult assignment was brought to light when the Bureau of Reclamation proposed the construction of a dam 6 miles downstream, where the Colorado River and Buffalo Creek meet. Although the dam would form back a reservoir which would put the present town of Robert Lee under an average of 12 feet of water, the 1,000 citizens gave almost unanimous approval to the idea.

Mayor Freeman C. Clark and his constituents were enthusiastic about the possibilities which could be provided by the 670,000-acre-foot lake to extend from the dam site up a score of canyons and valleys to near the Mitchell County line. According to plans, the reservoir would be 67 times as large as San Angelo's Lake Nasworthy.

The major function of the reservoir would be irrigation of 58,000 acres of Colorado Valley lands, including portions of Coke, Tom Green, Runnels, and Concho Counties.

Grazing Lands to Be Improved

From the 138-foot-high and 14,300-foot long dam, a canal 19 miles long would serve 5,500 acres of land near the river. Another canal 50 miles long and two secondary canals about 12 miles long would water 52,000 acres of land centering around Miles and Rowena with the eastern limit just west of Ballinger. The southern end would extend into Concho County.

At present about 80 percent of the project area is cultivated, the remainder being unimproved grazing lands. Members of the Upper Colorado River Authority, which is sponsoring the project, state that the value of the lands will be quadrupled. The present income averages $8.60 per acre per year.

Engineers estimate that present overgrazing of approximately 3,000,000 acres of native range lands will be reduced 30 percent in the four directly affected counties and down-river Coleman County.

Other livestock benefits would be found in supplying feed rations to maintain an additional 25,000 milk cows on the project and surrounding areas.

Pursuit of Happiness

To these practical gains are added the possibilities of resort and recreational benefits resulting from the scenic beauty provided by the lake, which can be utilized for fishing, camping, swimming, and boating.

Taking all these things into consideration, it is easy to see why the citizens of Robert Lee, and the farmers downstream are willing to go through another major moving operation, and are planning eagerly for a new life on the lake shore.

Pictures ——→

1. *Mayor Clark calls the town officials together to discuss the move to higher ground.* **2.** *Citizens of Robert Lee gather in Gerald Allen's drug store to start plans.* **3.** *In Mrs. Fred Campbell's modern beauty salon in Robert Lee, proprietor and patron talk about the advantages of having a lake view.* **4.** *This aged dwelling was built at the first stand and moved with Robert Lee down to the river. It plans to make the new trip.* **5.** *Ninety-two-year old blacksmith J. J. Vestal is eager to move to the new town site.* **6.** *Judge Wylie and Gerald Allen discuss moving the cement-block Coke County courthouse. The water will come up to here!*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LA FENDRICH


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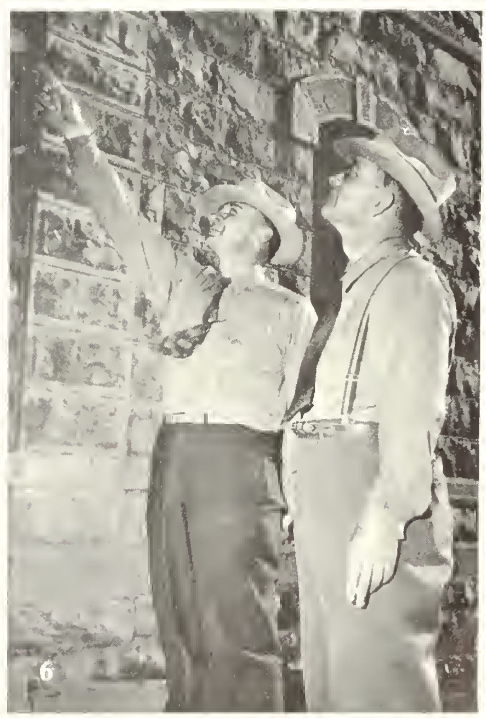
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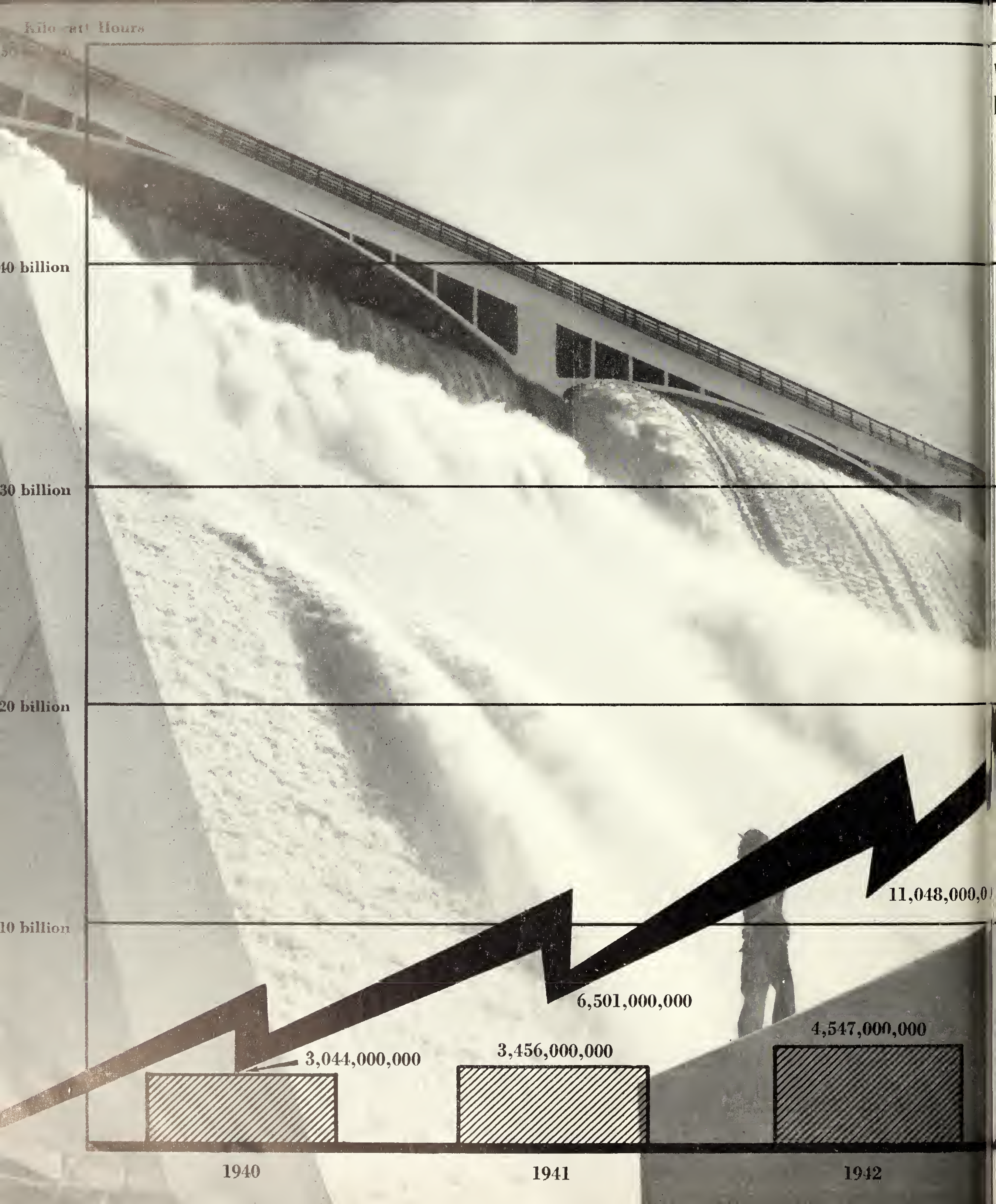
Giants



40 billion
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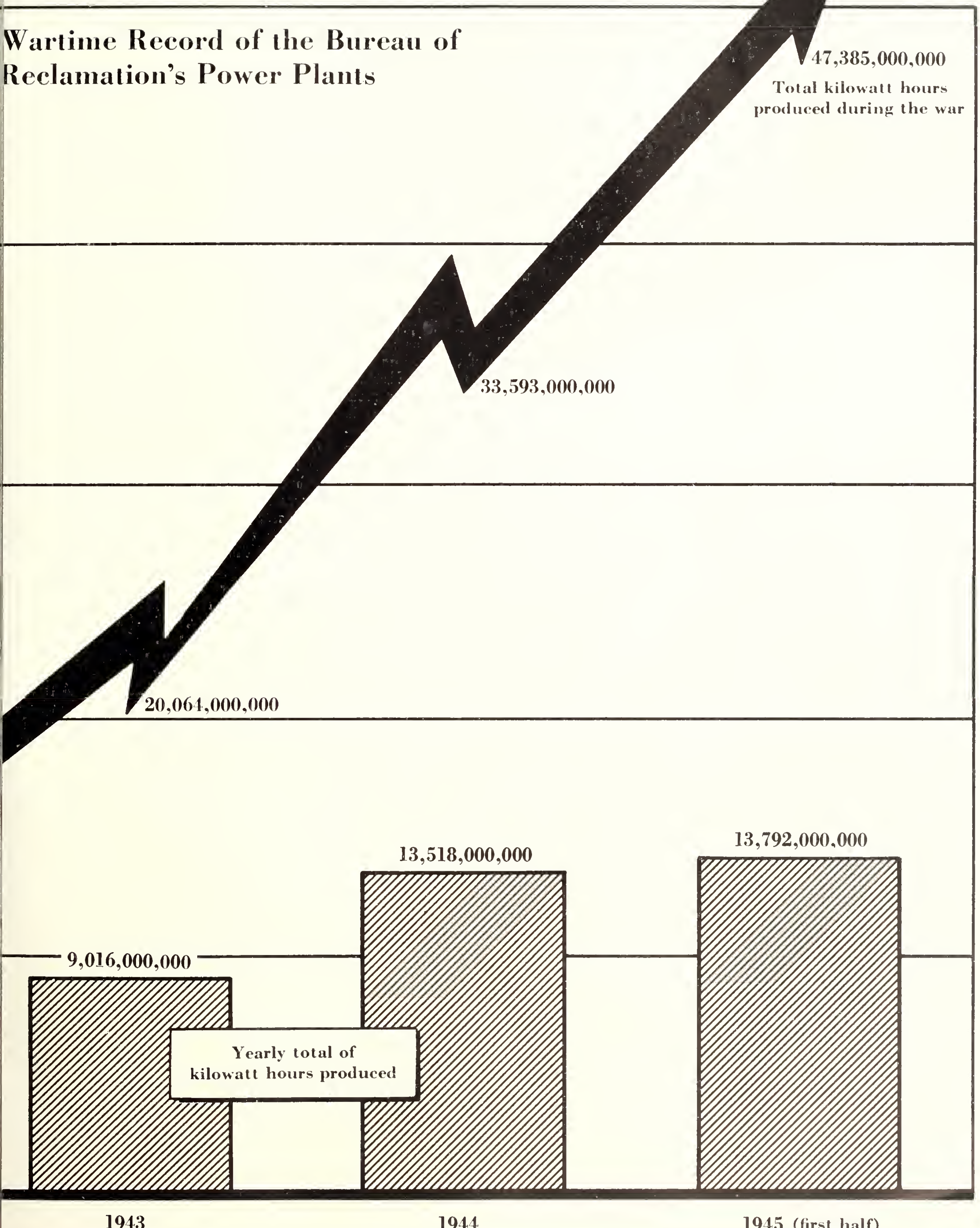
IN PEACE AND WAR



WARTIME RECORD

of Reclamation's Power Plants

Why did the Army locate the atomic bomb plant at Hanford, Wash.?

Who produced enough power to build almost 60,000 flying fortresses and 5,000 Liberty ships?

What made possible the production of from 30 to 40 percent of all the aluminum the United States used in its war planes?

The answer to these questions—and to many more of their kind—is, "The Bureau of Reclamation."

The Bureau of Reclamation produced the power that operated the Hanford plant. Not until the Bonneville Power Administration—which markets Grand Coulee's power—guaranteed that the energy would be made available to them around the clock did the Army undertake the atomic bomb project.

At the outbreak of the war, the United States had a third less available power than was at the disposal of the Axis nations. To meet this challenge, the Bureau quadrupled its hydroelectric output by 1944. Records for power production were broken by Boulder and Grand Coulee power plants, and by the Bureau as a whole. The "impossible" was accomplished time after time. Despite the shortages of materials needed for planes, bombs, tanks, and guns—resulting in stop orders on many planned installations—the Bureau of Reclamation has reason to be proud of the wartime record of its power plants.

Boulder and Coulee Served

Boulder Dam.—World-famed Boulder Dam, of the Boulder Canyon project in Arizona and Nevada, served busy war centers, airplane plants and industries producing steel, aluminum, magnesium, ammunition, ships, and synthetic rubber in Arizona, Nevada, and California. It also provided power in 1942–44 for the operation of a Las Vegas magnesium plant which required 196,000 kilowatts. An 82,500-kilowatt generator was added to the Boulder plant in 1942, another in 1943, and in November 1944 a third generator was placed in operation.

Boulder made history on June 11, 1943, when it carried an instantaneous peak load of more than a million kilowatts with a rated capacity of 952,300 kilowatts. This was the first time a single power plant operated at more than a million kilowatts

Never for one kilowatt-hour forsaking its trust as a public servant, Boulder Dam continued to regulate the Colorado River for downstream power plants and for the irrigation of the highly developed and richly productive lands in the Imperial Valley of California and the Gila and Yuma projects in Arizona. It served the city of Los Angeles by making available 1,000,000,000 gallons of domestic water a day, besides sending water to a dozen other wartime congested California cities along the coast. All this while holding the line against the destructive Colorado River floods, now a menace of the past.

Grand Coulee.—Grand Coulee Dam, key feature of the Columbia Basin project in Washington, may well be called the colossus in wartime production of power. Back in late 1941, shortly prior to Pearl Harbor, with war clouds hanging low, this plant had two 10,000-kilowatt generators in operation. At that time it seemed inconceivable that the plant would make the record it did during the next few years. Before the close of the war it had an installed capacity of 818,000 kilowatts. This battery of hydroelectric generators, six of which are the largest in the world, produced power equivalent to the labors of 16,000,000 men working steadily for 5 years, a total of more than 15 billion kilowatt-hours of electric energy. In terms of war production, this power would build 70 first-line battleships costing $80,000,000 each.

When the demands for Grand Coulee power looked as though they might exceed the supply at the peak of the war in 1943, a so-called "impossible" feat was accomplished which resulted in saving 2 years' construction time. Faced with the need for additional generators, with not enough time to build or complete them, two 75,000-kilowatt generators, fabricated for the Shasta plant in California, were rushed to Grand Coulee. The difficult task of transferring this large block of power from the manufacturers in the East and installing the equipment and machinery in record time was something that couldn't be done—but they did it.

Energy from Grand Coulee was all important in other phases of war production, contributing a huge power output to the aluminum reduction industry which manufactured about one-third of the Nation's pig aluminum in this area alone, where shipyards, metallurgical plants, and the largest carbide plant west of the Mississippi were located. Columbia River power, Grand Coulee and Bonneville combined, made possible the making of between 30 and 40 percent of the aluminum for the manufacture of all airplanes in the United States during the war.

As the "push" of 1943 became more intense, Grand Coulee established a world's record in early 1944 when its output for a single month reached 620,000,000 kilowatt-hours. Another record was established when the unit L–6, one of the newer 108,000-kilowatt generators, produced more than 522,000,000 kilowatt-hours while in continuous operation for a 6-month period. This giant generator was always overloaded during its entire record-breaking period of operation, carrying an average load of 115,000 kilowatts.

Power Does Double Duty

Parker power plant.—The Parker power plant on the Parker project between Arizona and California, besides continuing to pump irrigation water into the Valley of the Sun, including the city of Phoenix, Ariz., contributed to wartime production of Army aircraft and Navy patrol planes.

Shasta power plant.—The great Shasta plant, in the Central Valley project of California, although not starting production until 1944, ended the war with a total production of over 700,000,000 kilowatt-hours used to supply the Pacific Gas and Electric System with power, some of which went into manufacturing aircraft.

Elephant Butte power plant.—On the Rio Grande project in New Mexico, this plant started producing power in 1941. A transmission line was built to Alamagordo where the Army's White Sands Proving Grounds and the Alamagordo Air Base were located. Elephant Butte power was used for testing German V–2 rockets, among other ordnance weapons. It helped to weaken the might of the Axis, strengthen our defenses, and make the Allies' weapons invincible.

Air Bases Served

Although these are the more spectacular of the accomplishments of Reclamation power during the war, other power plants contributed vitally to war work.

In Wyoming, the Shoshone plant on the Kendrick project and the Pilot Butte plant on the Riverton project worked together as a team, pumping water for irrigation and supplying power for producing vitally needed oil supplies. The Green Mountain plant on the Colorado-Big Thompson project supplied power which released capacity for use in war centers near Denver, including two air bases which were used as modification centers for B–17's and B–29's, and the Rocky Mountain arsenal and ordnance

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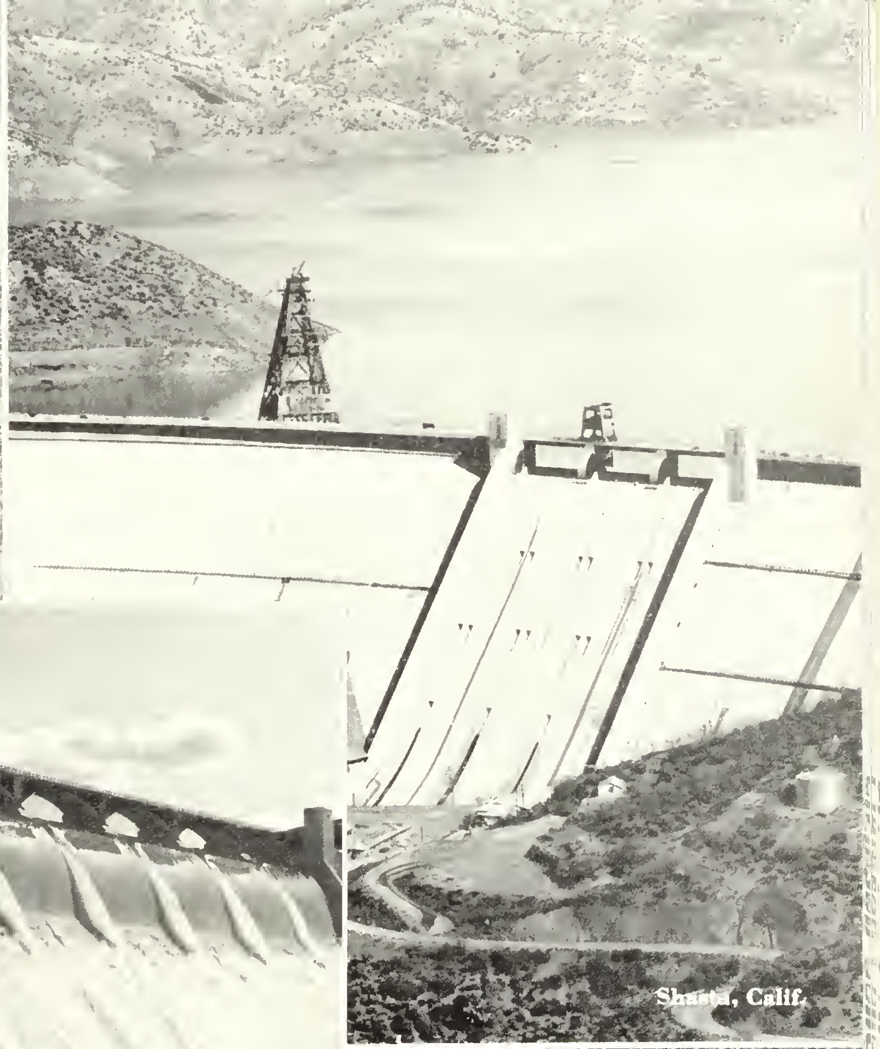
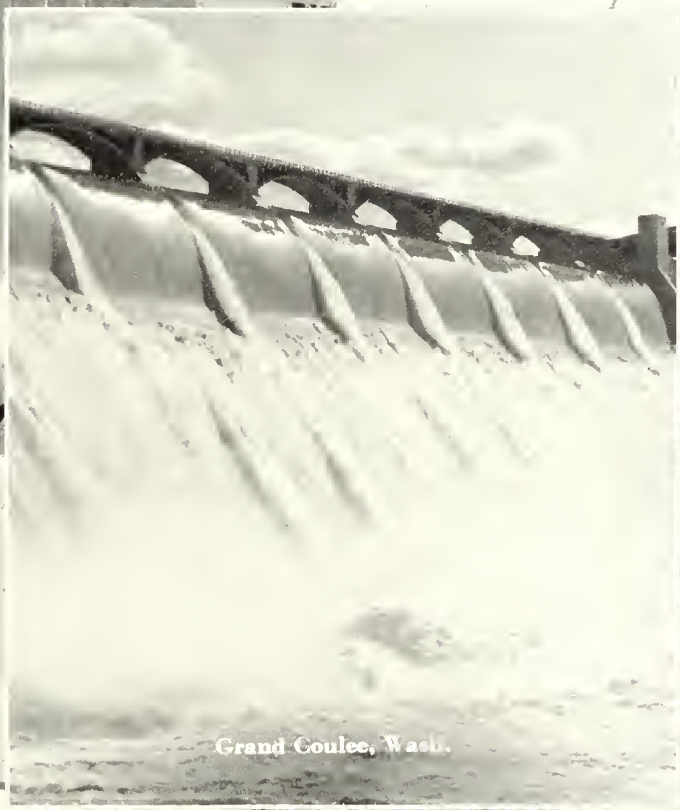
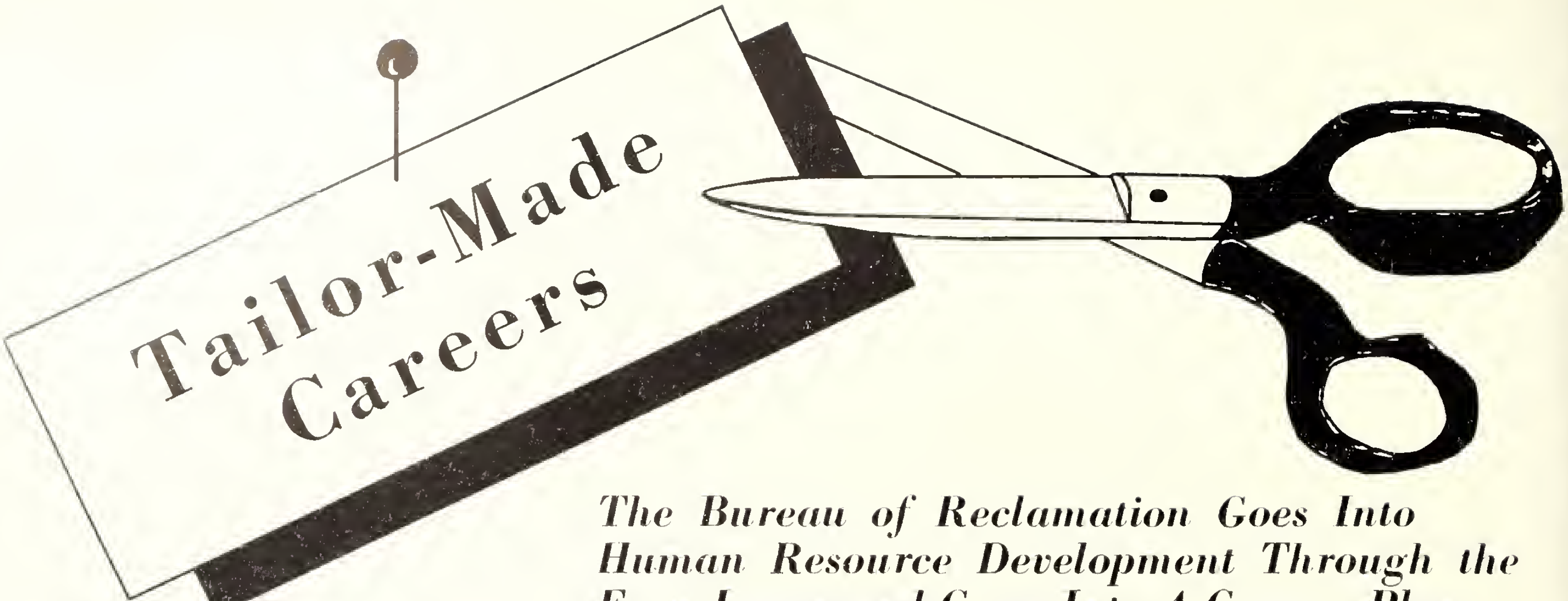
Elephant Butte, N. Mex.


Shasta, Calif.


Grand Coulee, Wash.


Parker, Ariz.


Boulder, Ariz.-Nev.



Tailor-Made Careers

The Bureau of Reclamation Goes Into Human Resource Development Through the Earn-Learn-and-Grow-Into-A-Career Plan

By GLENN D. THOMPSON
Chief Personnel Officer

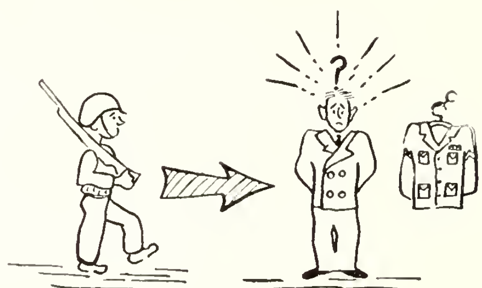
Ex-Corporal John Smith, veteran of 3 years fighting in the South Pacific, had a problem. He had wanted to become a civil engineer and had completed 2 years of his college course before he joined the Army. Now he needed a job to support his wife and the baby who had grown into a 4-year-old while he was away fighting. He'd have to forget about finishing college now. Maybe he could find work where he could at least use the engineering education he had and be close to his chosen field. So he applied to the Bureau of Reclamation for employment.

Mr. John Smith, participant in the work-and-learn plan of the Bureau of Reclamation, now has a future. He has a chance to complete his education in civil engineering and get practical work experience at the same time. Along with another employee of the Bureau, whom we shall call Mr. Robert Brown, he is a part of a two-man team.

Smith goes to school 3 months, while Brown is on the job in the Reclamation Bureau. Then Brown takes Smith's place in the classroom while our veteran learns to apply his book learning to the practical problems of an engineering assignment. In this way the particular job can be manned continuously.

The man who is working receives normal pay for the type of job he performs. Smith, through an approved agreement which the Bureau has with the Veterans' Administration, receives subsistence benefits for his part-time work while training on the job, and while attending school draws educational benefits provided under the so-called GI bill of rights. If he were a disabled veteran, he would receive these benefits through Public Law 16.

This is an example of the way the plan of the Bureau of Reclamation operates. It grew out of a need for well-trained men in diversified technical fields. Faced with a dwindling reservoir of available employees,



such as engineers for both design and construction service, scientists, mathematicians, and others needed to develop the water resources of the West, this plan was developed for the benefit of the veteran, the displaced war worker, the vocationally handicapped, and present employees of the Bureau.

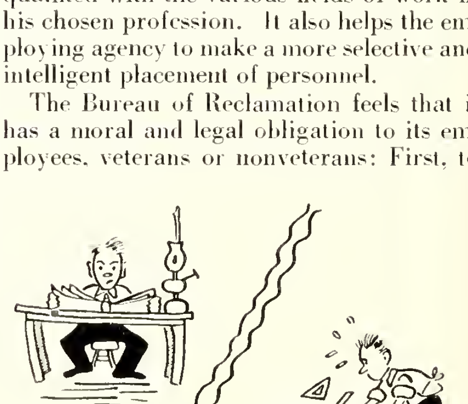
Veterans and employees have found that supervisors are able to develop additional plans within this flexible framework of work and study, ranging from pairing workers for alternating periods for as little as half a day. It is preferred that those who are placed on this program as new employees should have completed at least 2 years of academic study so that they can accomplish their fair share of productive work and also will not find the period for completing their college or technical preparation unduly long.

Where production schedules permit, an employee who lives near an educational institution participating in the plan is helped to work out a course of study which implements his on-the-job experience.

Through the various ramifications of the plan, the ways in which the work-and-learn plan operates are varied and adaptable to the needs of the individuals. The future engineer, the scientist, the economist, the administrator, and other classes of employees are able to get the most out of their training and put the most into the job they are to do.

The work-and-learn plan also helps to solve a problem of the technical colleges. Many of them are overcrowded and understaffed at a time when they need all their facilities to provide an adequate education for the professional workers of the future. The actual on-the-job practice serves as an extension of the college work in which the employee applies the theory he has studied. It gives him an opportunity to become acquainted with the various fields of work in his chosen profession. It also helps the employing agency to make a more selective and intelligent placement of personnel.

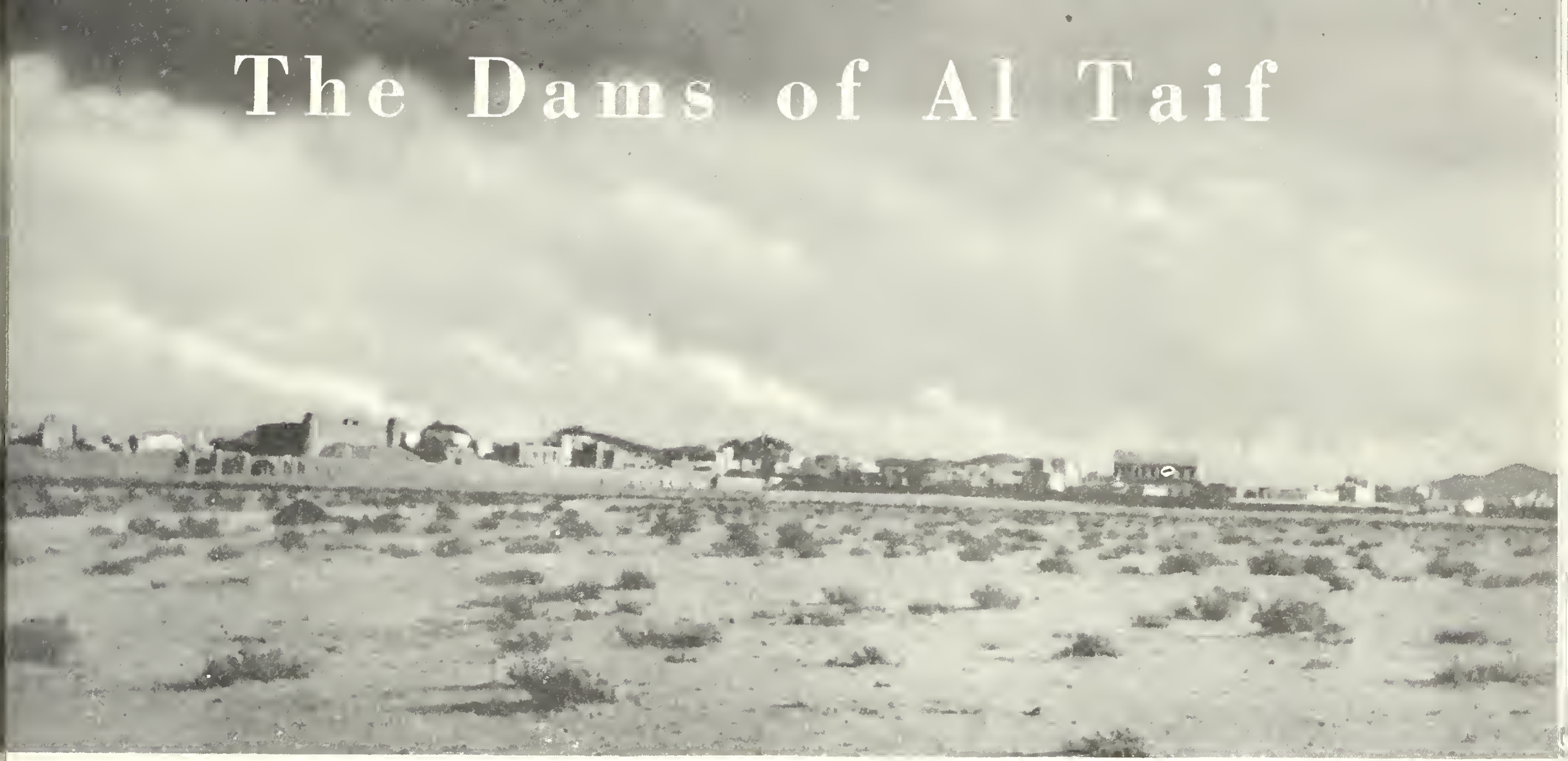
The Bureau of Reclamation feels that it has a moral and legal obligation to its employees, veterans or nonveterans: First, to



employ the veterans for their potential skills and give them an opportunity to make up the educational and technical qualifications which they sacrificed for the sake of serving their country in time of war; and, second, to develop the skills of those on the Bureau's staff who have excellent backgrounds and practical training but who have been unable

(Continued on p. 135)

The Dams of Al Taif



by MURDOCH J. McLEOD*

EAST of Mecca, high in the Hejaz Mountains, the long-hidden secret of ancient Arab power has been revealed in the crumbling dams of Al Taif.

Irrigation was the vital clue to the vanished wealth of Araby that drove the scimitar through Spain nearly to the heart of medieval Europe and within an eye-lash of world rule.

Al Taif half a thousand years ago was the paradise of the Hejaz. Nearly as high as Denver, 5,000 feet above the sea, its climate is cool and dry. Arab lore tells of scented gardens and shady groves in the midst of flourishing fields of corn. The sultans, the sherifs, and the sheikhs made Al Taif their summer home. Arab conquerors returning from the wars took their ease at Al Taif.

The shiny splendor of the Hejaz is gone now. The desert has walked up to the walls of Al Taif. The once spreading and verdant gardens have shrunk to withered girdles around the dwellings. Long drought has dried the wells. A pall of poverty shrouds the land.

Ancient Dams Remain

Only the remains of the dams squatting neglected in the gullied valleys, the traces of ancient fields, and the falling walls of ruined forts and palaces attest the abundant wealth of past centuries.

An Arab chieftain leading an American investigator to the Smallalaki Dam in Wadi Leiyah, a valley 20 miles southeast of Al Taif, suddenly blurted out, "By Allah, if this dam were repaired, it might restore fruitfulness to our valley."

Measured in inches, enough rain falls through the year for thriving corn fields, for orchards of fruits and dates, for abundant gardens. All too frequently it falls in the wrong season and so violently that flash floods rip unchecked down the valleys. The thunder showers are more feared than the droughts that at least do not wash off the top soil and destroy the buildings.

"Our prayers," the old Arab chief told the American softly, "are for the gentle rains that soak into the ground and supply our wells. Such rain we have not had for more than 3 years."

Al Taif rests near the base of a fluted cone of mountains and valleys. Surrounding it in a loose ring at distances of from 20 to 40 miles are the skeletons of the old dams that brought it prosperity 500 years ago. While most of the venerable structures have suffered serious damage, the largest of them, Smallalaki in the Wadi Leiyah, is apparently still in brand new condition. About 50 feet in height, 600 feet long, and 26 feet through the waist, Smallalaki Dam could go back in service today without alteration or repair. The cement holding the 60-cubic-feet blocks of stone used in the outer facing still holds firm.

Smallalaki evidently went out of use when the sluice gate in a channel cut through the valley wall at the end of the dam washed out. Traces of the old wall that apparently formed part of the outlet works remain in the channel. The cut averages nearly 90 feet wide and is at valley level. Through it the floods now bypass the dam. Settlers say that some years ago a flood of such intensity occurred that even this channel proved inadequate and a lake that formed behind the dam took 3 days to subside.

*Press Assistant, Information Division.

Second in size among the known dams only to Smallalaki, the Thelba Dam southwest of Al Taif is a modern-appearing structure smoothly plastered with cement on the top and upstream face. Thelba is approximately 300 feet long, 35 feet high, and 24 feet wide. A small channel at the foot of the dam near the end may have been the irrigation outlet. The entire center of the Thelba Dam has been washed away. An overflow channel 8 feet deep was cut through the rock beyond the dam abutment.

Many Washed Out

Thelba is a cut-stone and rubble structure built like a sandwich. The outer layer consists of large stone blocks cemented together and the filler consists of loose stones and rubble.

Most of the other dams have been nearly washed out and would have to be completely rebuilt before they could be used.

Following the discovery of the ancient dams of Al Taif, the valleys below them were searched intensively for traces of the irrigation canals which were supposed to have been built to carry the water to the fields. Although deserted plantations were discovered and extensive canal systems for the distribution of well water uncovered, no major canals were found anywhere near the reservoirs.

A small canal by no means large enough for irrigation purposes was discovered leading from a well about a mile above the Smallalaki Dam, then passing under the dam and leading to settlements several miles

downstream. It is believed that this canal once supplied the drinking water supply for the whole valley in ancient times and may conceivably predate the dam itself.

How, then, could the Arabs benefit from storage reservoirs without canals or other water-distribution works?

It appears fairly certain that they did not contemplate using the dams for storage but rather as a means of temporarily restraining the run-off, controlling floods, and recharging underground reservoirs so that irrigation water could be drawn from wells as needed.

Conditions Like California's

General conditions existing in the Hejaz are in many ways similar to those in the numerous river basins of southern and central California where planned storage of water in natural underground reservoirs was undertaken early in the last decade.

By the early 1930's wells in the Santa Clara and San Gabriele Valleys had been pumped down more than 100 feet, were constantly dropping lower, and flowing wells had ceased altogether. The Los Angeles County Flood Control District and the Santa Clara Valley Water Conservation District then built a series of low dams, diversions, and shafts, to permit rapid seepage of flood flows into the gravel layers underground.

Raising of water levels with consequent restoration of now dry wells and storage of large quantities of water underground is one of the presently accepted objectives of the Central Valley project.

Hundreds of years ahead of the Western World, no one knows how many centuries ago the Arabs apparently discovered that the cheapest water storage is in the natural reservoirs underground. The geologic formation favored such storage. There was no loss by evaporation. There was no need to build costly irrigation canals from the dam to the fields.

Desert Wealth Created

Thus, multiple-purpose flood control and irrigation dams were placed within the limits of their engineering skill and manpower. They could not have built the huge structures necessary for surface storage and flood control. The discovery and recognition of the principle of underground storage enabled them to establish a wealthy civilization in a forbidding desert.

Quixotically, the Arabs in the Hejaz today cannot repair the old dams because of their poverty, and they are poor because the dams fell into disrepair and the underground water sank out of reach. The valleys are slowly emptying of people. The farmers, as they are dried out and washed out, abandon their homes and return to the roving ways of the Bedouin. Yet the valleys are floored with rich alluvial soil and even many of the withered orchards could be revivified with a little water.

AFTER 500 YEARS—*Built an estimated 500 to 600 years ago, the Thelba Dam could be repaired at a cost very small in comparison to its usefulness. Second largest of the known dams in the Al Taif area, it is almost modern in appearance, with cement plastered on the top and upstream face. Thelba, built like a sandwich, is composed of cut stone and rubble. The center of the dam has been washed away. A small channel at the foot of the dam may have been the irrigation outlet.*

SECRET OF ARABIA—*Recently discovered by American investigators was this fresh water canal running from a well a mile above the 500- to 600-year old Smallalaki Dam, largest and best preserved of the ancient Al Taif dams. The canal passes under the dam and leads to settlements several miles below. It apparently supplied drinking water to the whole valley in ancient times. Traces of the old wall that was a portion of the outlet works are still visible in the channel.*

Tailor-Made Careers

(Continued from p. 132)

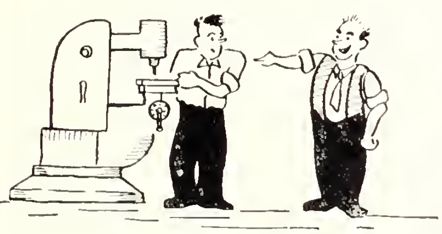
to progress to higher grades of employment and more responsible work because of educational deficiencies.

These responsibilities will be fulfilled when the present plans are extended in the near future.

This long-range plan has already been tried and tested at the Bureau's Branch of Design and Construction Office in Denver, Colo. It works. Applicants of a high calibre are being attracted in larger numbers because of the opportunity for training under this plan.

The "pilot school" or "testing ground" was the University of Colorado's College of Engineering. Representatives of the Bureau of the Budget showed a keen interest in working out this project. An Advisory Council on Training in the Bureau of Reclamation, composed of operating heads, worked closely with the training division in further implementing what some now refer to as the earn-learn-and-grow-into-a-career plan.

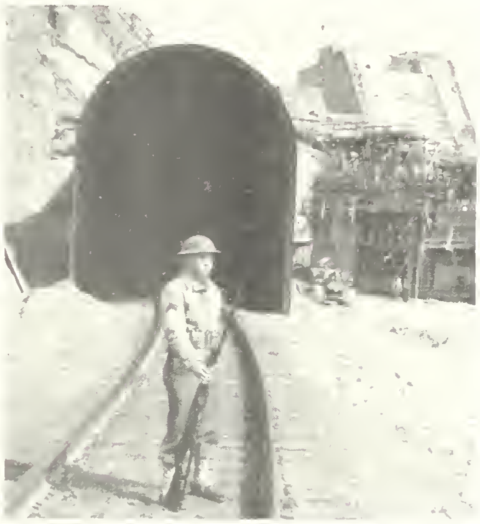
Other universities and colleges are now being approached with proposals to set up similar cooperative plans. The Bureau of Reclamation, which has developed skills in reclaiming wasted natural resources, is developing additional techniques for utilizing our greatest resource of all—manpower.



The gap is being closed between the GI and a job goal, between the GI as a student in the classroom and as a productive worker in the drafting room. By drawing the person, lecture hall, and laboratory closer to the work requirements, it is only a short step to a job on a Reclamation project.

SABOTEURS FOILED

Sabotage, the kind that dealt serious blows to the Nation's industrial plant in World War I, might have succeeded in World War II. Had it done so, Bureau of Reclamation projects—the dams that produced war power, the reservoirs that stored life-giving water for crops, the farms that grew food for the Nation—would have been almost certain targets.



LEST THERE BE SABOTAGE—*The United States Army guards the diversion tunnel at Shasta Dam which became a big producer of war power. This picture was made 4 days after Pearl Harbor.*

Take Boulder Dam, for intance. More than half of all the hydroelectric power used in southern California was generated there. Damage to this plant would have been damage to United States fighting capacity.

There was no successful sabotage here, however. Neither was there at Coulee Dam, giant power producer of the Pacific Northwest, nor at any of the other Reclamation projects that enabled the West to produce more for victory. And this despite the fact that these projects were show places from which—even during a global war—the public could not be entirely barred.

Complete absence of sabotage was not coincidental. It was the result of careful planning and precautions, of constant checking and cooperation by the Bureau of Reclamation, the armed services and local people.

Reclamation Rangers at Boulder grew from a prewar staff of 8 men to 64. They maintained a 24-hour boat patrol on Lake Mead, and a million persons, between Pearl Harbor and VJ-day, were convoyed across the dam and through the project's restricted area. Many arrests were made for the military, and potential saboteurs were stopped before they could go into action.

Similar protection was given Grand Coulee. Here the guard unit grew to 56 men, and the Coast Guard put another 40 to patrol waters above the dam.

The Bureau executed contracts with water users organizations for the protection of certain facilities, such as the Pine View Dam of the Ogden River project, the Hyrum, Moon Lake, and Strawberry Dams in Utah, and the Rye Patch Dam of the Humboldt project in Nevada.

On the Ogden River and Provo River projects, Utah, guards checked all airplanes overhead through special communication hook-ups with airports and law enforcement offices.

Veterans of World War I, local stockmen and businessmen, and former sheriffs and deputies were available for protection of Conchas Dam and Tucumcari irrigation works. Organized 2 years before the war, this Quay County (N. Mex.) sheriff's posse is still active. Commissioned deputy sheriffs, the men were organized in squads of six, subject to day and night call. Guns and ammunition were kept at the courthouse, and the incumbent sheriff was in charge.

In June 1944 the Tucumcari construction engineer reported: "In the past several months rather suspicious, though seemingly coincidental, events and bits of incriminating evidence point toward the possibility of sabotage and even espionage on this project." The sheriff's posse investigated, with the F. B. I. No acts of sabotage were committed.

Wartime Record of Reclamation's Power Plants

(Continued from p. 130)

plant which manufactured small caliber rifles, machine guns, and large shells.

Guernsey and Lingle, Minidoka, Boise River, Black Canyon, Prosser, Fort Peck, and Siphon Drop power plants, like many another home front worker, faced the steady day-by-day task of maintaining the civilian economy, pumping water so that food might be grown, our soldiers and our war workers fed, and water made available to war-impacted towns.

The astounding amount of electrical energy produced during the wartime period (1940 through 1945) by power plants operated by the Bureau of Reclamation reached a total of over 47 billion kilowatt-hours, enough to have made 59,000 flying fortresses, 5,000 Liberty ships, 10,000 Navy planes, 5,000 medium tanks, 79,000 .50-caliber machine guns, 31,000,000 .75-millimeter shells and 7,000,000 general purpose aircraft bombs.

In addition to the 18 power plants already mentioned, hydroelectric plants on Reclamation projects operated by companies or agencies other than the Bureau of Reclamation had distinguished war records. For example, copper and other mines, large food processing plants, an aluminum plant, along with four military air bases used for training pilots, were served by the Salt River project in Arizona. On many other projects, power was either made available for war purposes, or by taking care of normal and abnormal civilian demands, released power from other sources for war production.

Ready in war to insure the safety of the Nation, the Bureau's mighty power plants are ready now to pour out their energy on the equally challenging tasks of peace.

THE DAM AND THE MAN —*Shoshone Dam in Wyoming, now re-christened Buffalo Bill Dam by Presidential order, shown with an insert of its picturesque namesake, William F. Cody, in full regalia during his early wild West days.*

WYOMING

Buffalo Bill Returns As Shoshone Dam Is Renamed

On Monday, March 11, President Truman signed legislation changing the name of Shoshone Dam to Buffalo Bill Dam, in tribute to the famous frontiersman for his interest in pioneer reclamation development.

A fitting memento to the intrepid William F. Cody, more popularly known as Buffalo Bill, is the former Shoshone Dam. Located in a narrow granite gorge on the Shoshone River, 7 miles west of Cody, Wyo., on the highway to the Cody entrance to Yellowstone Park, this dam, completed in 1910, is one of the earliest Bureau of Reclamation projects. Its building challenged the ingenuity of engineers. Its potentialities fired the spirits of hardy pioneers who came to settle on the lands made fruitful by the waters it stored and shared.

Buffalo Bill Dam is the mainspring for the Shoshone project of Wyoming. A rubble concrete structure of the constant radius arch type, 328 feet in maximum height, it is similar in design to the Pathfinder Dam, also in Wyoming, both being high structures in narrow granite gorges. The top thickness is only 10 feet, and the canyon at the dam site is 70 feet wide at normal stream bed and 200 feet wide at an elevation of 300 feet above the stream bed. Behind this granite-based structure, the Buffalo Bill Reservoir stores 456,600 acre-feet of water.

Five Divisions Irrigated

Three of the five divisions of the Shoshone project, Garland, Frannie, and Willwood, have been irrigated from Buffalo Bill Dam by means of canals, laterals, ditches, and structures which deliver the water by gravity directly to each farm.

For the remaining two divisions of the Shoshone project, the Heart Mountain and Oregon Basin divisions, however, water must be taken from the reservoir about 100 feet above the stream bed, as the irrigable lands of these divisions are located at considerably higher elevations than the lands of the completed divisions.

As the average precipitation is about 6 inches per year, farming is entirely dependent upon irrigation—and irrigation is entirely dependent upon Buffalo Bill Dam.

Steeped in the traditions of the West, flanked by Rattlesnake Mountain on one side and Cedar Mountain on the other, Buffalo Bill Dam will continue to be the

SPEAKING OF NAMES . . .

The Shoshone project, on which the newly named Buffalo Bill Dam and reservoir are located, was named after the range of mountains and the river which is the source of water for the project. However, the Indians originally gave the river the unattractive name of "Stinking Water" because of the sulphur springs near the mouth of Shoshone Canyon. The Wyoming Legislature, on February 14, 1901, officially fixed the name as Shoshone, after the Shoshoni tribe of Indians. Six weeks later the Board of Geographical Names in the Department of the Interior adopted the name as fixed by the legislature. The reason for changing the last letter of the name from "i" to "e" is not known.

So far as the naming of the Heart Mountain division is concerned, there is a slight disagreement on the matter of spelling. Residents around Cody, Wyo., spell it "Hart." Other people on the project adhere to the spelling of "Heart," which is the official name given the division by the Bureau of Reclamation, logically enough because of the heart-shape of Heart Mountain.

The naming of the Willwood division of the Shoshone project is also a matter of some dispute. Most people believe that it is a combination of part of some person's first and surname. This interpretation could apply to Wilford Woodruff, an official of the Mormon Church, who was active in reclaiming the Big Horn Basin. On the other hand, there are some who believe the division was named in honor of Will Wood, former member of Congress who was at one time Chairman of the Subcommittee on Appropriations for Reclamation.

The Frannie division of the Shoshone project seems to be named, along with the town of Frannie, after Frannie Morris, cowgirl daughter of a ranchman who made herself and the town famous by her picturesque and typically Western manner, particularly in the matter of carrying the mail from the train to the ranch post office where her father was postmaster of the Frannie station. Paternal and local pride were no doubt responsible for the naming of the Frannie station in 1901, later the town and Frannie division of the Shoshone project.

onors the Past and Plans for the Future

stopping-off place for tourists who take the Cody-Yellowstone highway to Yellowstone National Park, along the Shoshone Canyon. There, between the turbulent Shoshone River and the sheer cliffs, Buffalo Bill is commemorated in a manner suitable to this colorful figure of the past. He will be remembered in a thousand ways as the water stored by the dam which bears his name turns more arid lands into flourishing farms. Buffalo Bill Dam and Buffalo Bill Reservoir knit together the past and the future. They challenge those who, like the frontiersmen of the past, have the will, the daring and the resourcefulness to turn the wastelands into homelands in Wyoming.

In Shoshone Canyon, directly above the Shoshone River siphon, the Bureau of Reclamation plans construction of the Heart Mountain power plant.

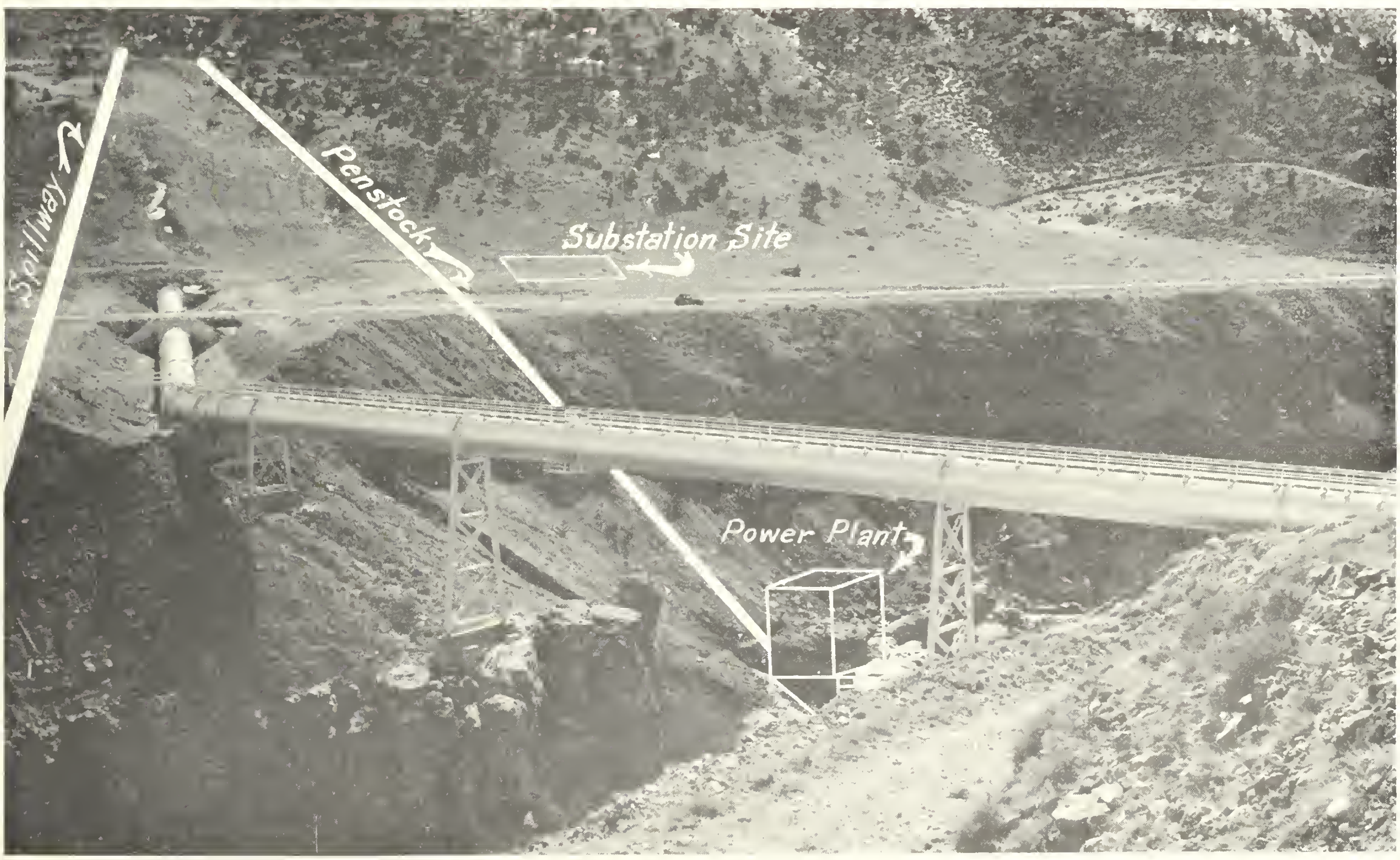
The construction of this power plant will add 5,000 kilowatts capacity at a point where it is now greatly needed. Increased activity in the northern Wyoming oil fields, the construction of additional Rural Electrification Administration systems, and post-war industrial expansion in the Big Horn Basin have made demands on the Shoshone project power system, requiring more than full capacity. The plant also will be of direct benefit to project water users in that it will repay part of the cost of the Shoshone Canyon conduit. This conduit, which heads at Buffalo Bill Dam, is approximately 3 miles long with an initial capacity of 1,200 second-feet.

Inverted Siphon Used

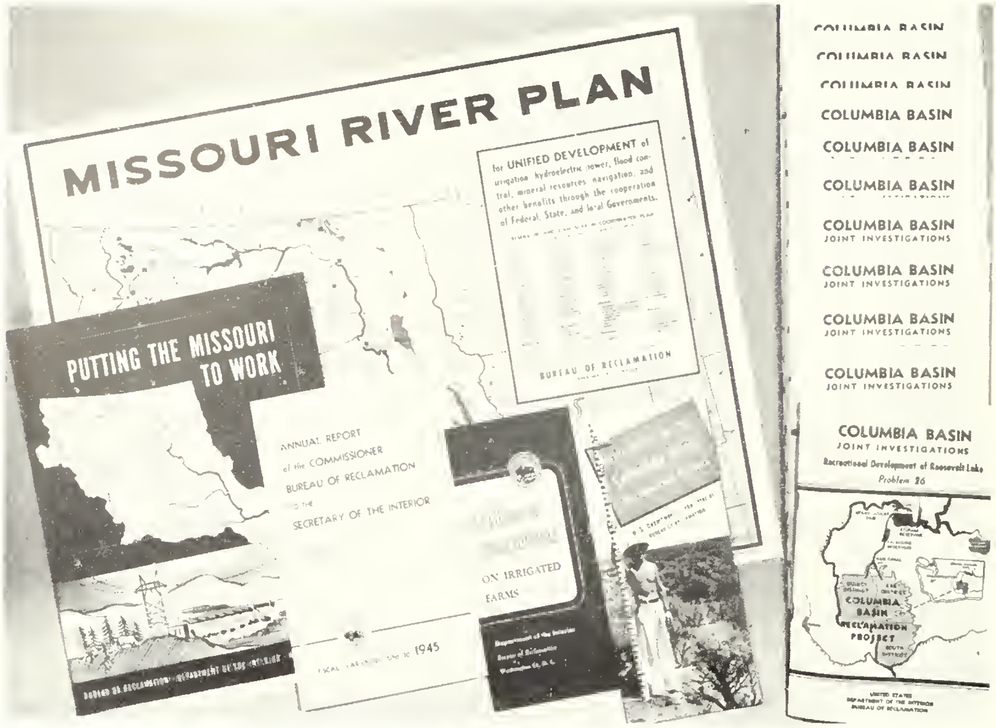
The Heart Mountain Canal, which begins at the outlet of the Shoshone Canyon conduit, is carried over the Shoshone River by an inverted siphon of 914 second-feet capacity. Some 20 miles of the Heart Mountain Canal and 28 miles of the lateral system were first operated during the 1943 irrigation season for the delivery of water for domestic and irrigation use to the War Relocation Authority, operating the Heart Mountain Relocation Center established for temporary settlement of Japanese evacuees.

The Heart Mountain power plant will become part of the Shoshone-Riverton-Kendrick power system. Downstream from the Buffalo Bill Dam is a three-unit power plant of 7,000-kilovolt-ampere capacity, supplying power through Bureau of Reclamation and private distribution lines to the entire Big Horn Basin. This plant is connected with the Pilot Butte power plant on the Riverton, Wyo., project, by a line from that plant to Thermopolis, Wyo., and both these systems are interconnected with the system of the Kendrick project's Seminoe plant. With the completion of the Heart Mountain plant, an important link will be supplied in this chain.

Part of the Heart Mountain division of the Shoshone project will be opened for settlement this summer. The Oregon Basin division is a development contemplated for the future.



Hydroelectric power will replace horsepower at the planned Heart Mountain power plant in the Shoshone project area in Wyoming.



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Recent Bureau Publications

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River system. Fifteen cents a copy from the Superintendent of Documents, Washington, D. C.

2. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to your Regional Director.

3. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ended June 30, 1945). Obtainable on request to the Bureau of Reclamation as directed above.

4. *Boulder Dam.*—Illustrated folder on the world's highest dam. Obtainable on request to the Bureau of Reclamation at Washington or Boulder City, Nev.

5. *Approved Missouri River Plan Map.*—Color map showing reservoir and dam sites in the basinwide construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

6. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. May be obtained from the Superintendent of Documents under the following titles:

Problem 2. *Types of Farming*—75 cents.
Problem 3. *Insuring Proper Land Use*—10 cents.
Problems 4–5. *Irrigation Water Requirements*—30 cents.
Problem 9. *Farm Improvement*—20 cents.
Problem 17. *Development Rate of Project Lands*—10 cents.
Problem 19. *Highway Development*—15 cents.
Problem 21. *River Transportation*—10 cents.
Problem 25. *Rural Recreational Areas*—30 cents.

Miscellaneous Publications

"What the Federal Bureau of Reclamation Helps to Do for the People of the West," by Curtis R. Fuller, in *Western States Reclamation Journal*, April 30, 1946, page 11. Illustrated. The story of a highly successful homesteader on the Boise (Utah) project of the Bureau of Reclamation.

"An Expanding Reclamation Program," by Kenneth Markwell, Assistant Commissioner, Bureau of Reclamation, in *Civil Engineering*, May 1946, page 207. Illustrated.

Irrigation Companies in Utah—Their Activities and Needs, by Orson W. Israelsen, J. Howard Maughan and George P. South, March 1946, Bulletin 322, Agricultural Experiment Station, Utah State Agricultural College, Logan, Utah, in cooperation with Division of Irrigation, U. S. Soil Conservation Service, and Utah State Department of Publicity and Industrial Development. 62 pages with illustrations.

Soil Erosion in Small Irrigation Furrows, by Orson W. Israelsen, George D. Clyde and Cyril W. Lauritzen, January 1946. Bulletin 320, Agricultural Experiment Station, Utah State Agricultural College, Logan, Utah, in cooperation with the U. S. Soil Conservation Service. 39 pages with illustrations.

"Columbia Basin Project Starts This Year," by Frank A. Banks, supervising engineer, Bureau of Reclamation's Columbia Basin project in Washington State, in *Engineering News-Record*, May 16, 1946, page 70. Illustrated.

Recent Project Maps

Published by the Bureau of Reclamation

Western Half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 x 20 inches, FREE.

Orland Project California, Map No. 45–45, (supersedes No. 21880). Blue, green, and black. Size 8 x 10½ inches, price 10 cents.

Grand Valley project, Colorado, Map No. 45–40, (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 x 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52, (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 x 20 inches, price 25 cents.

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Notes to Contractors

Construction and Supply Contracts Awarded During Month of April

Specification No.	Project, division, and State	Date contract awarded	Description of work or materia	Contractor's name and address	Contract amount
1149	Parker Dam—California	Apr. 3	Steel partition and housing for Parker power plant.	California Steel Products Co., Richmond, Calif.	$7,013.00
1151	Missouri Basin—Kortes unit—Wyoming.	Apr. 10	Construction of Kortes Dam and power plant	Morrison-Knudsen Co., Boise, Idaho	4,688,000.00
1154	Central Valley—Friant—California	Apr. 6	Install drum gates, control equipment, metal work, dismantle trestle at Friant Dam.	Consolidated Steel Corp., Los Angeles, Calif.	134,150.00
1157	Central Valley—Kennett—California	Apr. 18	Ventilating equipment for Keswick power plant	Westinghouse Electric Co., Denver, Colo. Schedule 1	2,059.20
1161	Davis Dam—Arizona	Apr. 30	Gate frames for penstocks at Davis Dam	Lakeside Bridge & Steel Co., Milwaukee, Wis.	92,200.00
1162	Central Valley—Kennett—California	Apr. 3	Steel towers for transmission lines, Oroville-Sacramento.	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	473,545.00
1163	do	Apr. 9	Operating unit with control equipment, and inlet and discharge pipes for fish trap at Keswick Dam.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	6,434.00
1164	Shoshone—Heart Mountain—Wyoming.	Apr. 13	Construction of Heart Mountain Canal, station 1227+00 to station 1411+50; lateral H 65-12 extension, station 88+60.78 to station 155+00; laterals H-122, H-130, H-136, H-141, H-141-1, and H-141-17; Alkali Creek drain; storm water drains "A" and "C."	Wyoming Construction Co., Laramie, Wyo. Schedule 1.	90,041.50
				Otis Williams and Co., Helena, Mont. Schedules 2 and 3.	124,392.80
1169	Colorado-Big Thompson—Colorado	Apr. 9	35 two-bedroom prefabricated houses, Estes Park government camp; 35 two-bedroom prefabricated houses, Ft. Collins government camp; 30 two-bedroom prefabricated houses, Shadow Mountain government camp.	Winter-Weiss Manufacturing Co., Denver, Colo.	205,300.00
1171	Central Valley—Friant—California.	Apr. 8	Construction of earthwork, canal lining and structures, station 1144+00 to station 1591+66.15, Friant-Kern Canal.	Peter Kiewit Sons' Co., San Francisco, Calif.	1,598,856.00
1172	Central Valley—Delta—California.	Apr. 18	Construction of earthwork, canal lining and structures, station 2321+25 to end, Contra Costa Canal, and Mountain View reservoir.	Parish Brothers, Benecia, Calif	568,974.50
1173	Central Valley—Friant—California	Apr. 30	Schedule 1—Needle valves, and	Joshua Hendry Iron Works, San Francisco, Calif	98,112.00
			Schedule 2—Hollow-jet valves; both for Madera and Friant-Kern Canals and river outlet at Friant Dam,	Hardie-Tynes Manufacturing Co., Birmingham, Ala.	332,202.00
1176	Boise—Idaho	Apr. 25	15-ton traveling crane for government warehouse at Anderson Ranch Dam.	Milwaukee Crane & Service Co., Cudahy, Wis	6,985.00
1177	Central Valley—Kennett—California	Apr. 4	Oil storage tanks for Keswick power plant	Willamette Iron & Steel Co., Portland, Ore.	7,590.00
1179	Altus—Oklahoma	Apr. 11	Earthwork, structures, station 1+00 to station 590+36, West Canal.	Stebbins Construction Co., Tulsa, Okla	185,712.00
1180	do	Apr. 11	Earthwork, structures, lateral 9.9 extension and lateral 11.1, Altus City pipeline, city laterals and sublaterals.	Jones and Phelps Construction Co., Oklahoma City, Okla.	154,915.00
1185	Missouri Basin—Frenchman-Cambridge unit—Nebraska.	Apr. 20	20 two-bedroom prefabricated houses for Enders government camp.	Green Lumber Co., Laurel, Miss	52,000.00
1187	Columbia Basin—Washington	Apr. 24	Construction of earthwork, main canal, station 751+94 to station 1100+90.8.	Morrison-Knudsen Co., Seattle, Wash.	619,000.00
1190	Gila—Yuma-Mesa—Arizona	Apr. 11	Concrete irrigation pipe and reinforced concrete turnout headwalls.	Peerless Concrete Pipe Corp., Santa Ana, Calif	131,200.00
1191	Hungry Horse—Montana	Apr. 13	50 two-bedroom prefabricated houses for Hungry Horse government camp.	Green Lumber Co., Laurel, Miss	132,100.00
1202	Missouri Basin—Kortes unit—Wyoming.	Apr. 22	Schedules 1 and 4—Transformers, disconnecting switches, and circuit breakers.	Allis-Chalmers Manufacturing Co., Milwaukee, Wis.	11,520.00
1205	Davis Dam—Arizona-Nevada.	Apr. 27	Gate frames and anchorages for spillway regulating gates.	Omaha Steel Works, Omaha, Nebr	51,900.00
1206	do	Apr. 25	Construction of 7 six-room residences and 13 five-room residences for Davis government camp.	W. S. Ford, Kingman, Ariz.	198,205.00
1224	Boulder Canyon—Arizona—California-Nevada.	Apr. 4	Permanent runners with filler rings for turbines, units A-5, A-6, and A-7, Boulder power plant.	Allis-Chalmers Co., Milwaukee, Wis	222,940.00
1248	Missouri Basin—Boysen unit—Wyoming.	Apr. 27	Steel, siding, windows, doors, etc., for steel warehouse for Boysen government camp.	American Bridge Co., Denver, Colo.	11,030.00
1249	Hungry Horse—Montana	Apr. 30	Steel, siding, roofing, windows, doors, ventilators for steel warehouse building at Hungry Horse Dam.	do	44,760.00
1260	Colorado-Big Thompson—Colorado	Apr. 23	Preparation of concrete aggregates	Schmitt Construction Co., Kremling, Colo	99,000.00
1261	Yakima—Roza—Washington	Apr. 20	Furnish sand and gravel	W. S. Tolley & Co., Zillah, Wash	42,177.00
1268	Colorado-Big Thompson—Colorado	Apr. 30	Power circuit breaker for Loveland-Estes transmission line.	Westinghouse Electric Co., Denver, Colo.	10,967.00

(Continued on page 140)

Construction and Supply Contracts Awarded During Month of April

(Continued from page 139)

Specification No.	Project, division and State	Date contract awarded	Description of work or material	Contractor's name and address	Contract amount
	REGION I				
1896	Columbia Basin, Washington	Apr. 19	Transfer of 150 houses from Vancouver to Coulee Dam, Wash.	Home Builders, Inc., Vancouver, Wash	$66,175.44
	REGION III				
RIII-1	Boulder Canyon—California-Arizona-Nevada.	Apr. 5	Reroofing government houses at Boulder City	Las Vegas Roofing Co., Las Vegas, Nev	5,133.42
RIII-235	Planning office, Boulder City, Nevada.	Apr. 5	Evaporative coolers	Luce and Goodfellow, Inc., Las Vegas, Nev	1,356.00
B. P. I. Inv. U. S. D. A.	Gila—Arizona.	Apr. 2	Portable pipeline system	W. R. Ames Co., San Francisco, Calif	4,580.70
	REGION IV				
RIV-1	Provo River—Utah	Apr. 5	Sand and gravel	Salt Lake Valley Sand & Gravel Co	1,950.00
	REGION V				
1-78r-57	Colorado River, Texas	Apr. 30	Oil asphalt	Humble Oil & Refining Co., Houston, Tex	2,200.00
	REGION VI				
1205	Missouri Basin—Knife River unit—North Dakota.	Apr. 5	Earth drills	Western Construction Equipment Co., Billings, Mont.	7,790.00
1318	Missouri Basin—Angostura unit—South Dakota.	Apr. 4	Diamond core drilling	J. L. Havlick, Spokane, Wash	11,125.00
1355	Missouri Basin—Tiber unit—Montana.	Apr. 9	Core drilling	Vivian Brothers, Chester, Mont	11,125.00
1434	Missouri Basin—Huron unit—South Dakota	Apr. 19	Rental of dragline	W. E. Bartholow & Son Construction Co., Huron, S. Dak.	1,200.00
1446	Missouri Basin—Boysen unit—Wyoming.	Apr. 19	Test pits	W. E. Barling, Inc., Meteetse, Wyo.	2,000.00
1450	Missouri Basin—Boysen unit—Wyoming.	Apr. 19	Purchase of concrete	Charles M. Smith, Thermopolis, Wyo	3,500.00

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Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

(Continued from inside back cover)

Project	Organization	Office	Operating official: Name	Operating official: Title	Secretary: Name	Secretary: Address
Hyrum	South Cache Water Users Association	Hyrum, Utah	Norval T. Kitchen	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Board of control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton.	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy.	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell.	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	do	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Philip Hibel	Superintendent.	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr	President	Joseph R. Tudenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington, Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	Arlie S. Campbell	do	William T. Davis	Brigham City, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	H. J. Lawson	Superintendent.	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	do	E. F. Andrews	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo F. Clark	do	F. A. Baker	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hansen	Manager	A. R. Hansen	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

U. S. GOVERNMENT PRINTING OFFICE. 1946

Personnel and Project Directory

J. A. KRUG, SECRETARY OF THE INTERIOR

Commissioner's Office

Michael W. Straus, Commissioner — Kenneth Markwell, Assistant Commissioner — William E. Warne, Assistant Commissioner

Clifford E. Fix, Chief Counsel; T. W. Mermel, Acting Assistant to the Commissioner—Engineering; G. S. Ellsworth, Assistant to the Commissioner—Management; Barrow Lyons, Chief Information Officer; William F. Kubach, Director of Finance; Glenn D. Thompson, Chief Personnel Officer; Kenneth F. Vernon, Progress Control Officer; C. A. D. Young, Director of Supply

Branch Directors

John W. Dixon, Director, Branch of Project Planning; Walker R. Young, Chief Engineer and Director, Branch of Design and Construction (Denver); Harvey F. McPhail, Director, Branch of Power Utilization; Goodrich W. Lineweaver, Director, Branch of Operation and Maintenance

Regions (Space does not permit complete list of offices within the regions)

Regional offices	Field offices	Location	Official in charge	
			Name	Title
REGION 1—R. J. Newell, director, Boise, Idaho.	Central Snake (district).	Boise, Idaho	George N. Carter.	Acting district engineer.
	Anderson Ranch Dam.	Anderson Dam, Idaho.	Vacancy.	Construction engineer.
	Deschutes	Bend, Oreg	C. H. Spencer	Do.
	Yakima	Yakima, Wash	D. E. Ball	Superintendent.
	Roza division	do	H. T. Nelson	Construction engineer.
	Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Supervising engineer.
	Ephrata office	Ephrata, Wash	H. A. Parker	Engineer.
	Project development.	do	W. W. Johnston.	Acting supervisor.
	Minidoka	Burley, Idaho	S. R. Marean	Superintendent.
	Palisades	Idaho Falls, Idaho.	I. Donald Jerman.	Project engineer.
	Hungry Horse	Kalispell, Mont	Paul A. Jones	Do.
	Umatilla	Pendleton, Oreg	C. L. Tice	Reservoir superintendent.
	Rathdrum Prairie	Coeur d'Alene, Idaho.	Louis B. Ackerman.	Construction engineer.
	Bitterroot	Hamilton, Mont.	T. R. Smith	Do.
	Missoula Valley	do	do	Do.
REGION 2—R. L. Boke, director, Sacramento, Calif.	Central Valley			
	Kennett division.	Redding, Calif	I. C. Harris	Acting construction engineer.
	Friant division	Friant, Calif	R. K. Durant	Do.
	Delta division	Antioch, Calif	O. G. Boden	Construction engineer.
	Klamath	Klamath Falls, Oreg.	E. L. Stephens	Superintendent.
	Orland	Orland, Calif	E. R. Asdell	Do.
	Project planning	Santa Barbara, Calif.	J. H. Fertig	Engineer
REGION 3—E. A. Moritz, director, Boulder City, Nev.	All-American Canal.	Yuma, Ariz	J. K. Rohrer	Acting construction engineer
	Gila	do	J. K. Rohrer	Do.
	Yuma	do	W. A. Boettcher	Superintendent.
	Coachella Canal	Coachella, Calif	C. S. Hale	Division engineer.
	Boulder Canyon	Boulder City, Nev.	C. P. Christensen.	Director of power.
	Davis Dam	Kingman, Ariz	H. F. Bahmeier.	Acting construction engineer.
	Parker Dam Power.	Parker Dam, Calif.	S. A. McWilliams.	Construction engineer.
	San Diego	Escondido, Calif	R. B. Ward	Engineer.
	Project planning	Phoenix, Ariz	V. E. Larson	Assistant regional planning engineer.
REGION 4—E. O. Larson, director, Salt Lake City Utah.	Eden	Rock Springs, Wyo.	E. V. Hillius	Chief clerk.
	Grand Valley	Grand Junction, Colo.	T. L. Sundquist	Superintendent.
	Mancos	Mancos, Colo	A. W. Bainbridge.	Resident engineer.
	Newton	Logan, Utah	E. J. Wick	Engineer.

Regional offices	Field offices	Location	Official in charge	
			Name	Title
REGION 4—Continued	Pine River	Bayfield, Colo	S. F. Newman	Reservoir superintendent.
	Provo River	Provo, Utah	L. R Dunkley	Construction engineer.
	Scofield	Price, Utah	P. R. Neeley	Do.
REGION 5—W. R. Nelson, director, Amarillo, Tex.	San Luis Valley	Monte Vista, Colo.	D. M. Forester	Project engineer.
	Valley Gravity	McAllen, Tex	C. P. Seger	Area planning engineer.
	Tucumcari	Tucumcari, N. Mex.	M. P. Starr	Acting construction engineer.
	Altus	Altus, Okla	H. E. Robbins	Construction engineer.
	Rio Grande	El Paso, Tex	L. B Fiock	Project superintendent.
	Ysleta office	Ysleta, Tex	F. D. Postle	Division superintendent.
	Las Cruces	Las Cruces, N. Mex.	E. S. Mayfield	Do.
	Carlsbad	Carlsbad, N. Mex.	T. B. Thomas	Acting project superintendent.
REGION 6—H. D Comstock, director, Billings, Mont.	Belle Fourche	Newell, S. Dak	S. T. Larsen	Superintendent.
	Buffalo Rapids	Terry, Mont	W. L. McClure	Acting construction engineer.
	Fort Peck	Fort Peck, Mont.	Allen Mattison	Resident engineer.
	Intake	Terry, Mont	W. L. McClure	Acting construction engineer.
	Milk River	Malta, Mont	H W. Genger	Superintendent.
	Rapid Valley	Rapid City, S. Dak	H. V. Hubbell.	Construction engineer.
	Riverton	Riverton, Wyo	D L. Carmody	Superintendent.
	Shoshone	Powell, Wyo	L. J. Windle	Do.
	Heart Mountain division.	Cody, Wyo	W. L. Kemp	Construction engineer.
	Sun River	Fairfield, Mont	C. L. Bailey	Superintendent.
	Missouri River			
	Project development staff.	Billings, Mont	W. E. Rawlings	Supervisor.
	Boysen Dam	Thermopolis, Wyo.	R. S Lieurance	Project engineer
REGION 7—E. B. Debler, director, Denver, Colo.	Colorado-Big Thompson.	Estes Park, Colo.	C. H Howell	Do.
	Mirage Flats	Hemingford, Nebr.	D. J. Paul	Construction engineer.
	North Platte district.	Casper, Wyo	I. J. Matthews	District engineer.
	Missouri Basin			
	Frenchman-Cambridge.	McCook, Nebr	H E. Robinson	Project engineer.
	Kortes (under North Platte district)	Casper, Wyo	I J. Matthews	District engineer.
	Project planning	Grand Island, Nebr.	P. L. Harley	Engineer.
	do	Pueblo, Colo	B. F. Powell	Do.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D G. Leslie	Superintendent.	C. J. McCormick	Grand Junction, Colo.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H S. Elliott	Ballantine, Mont.

(Continued on page 140)

Work Starts at Davis Dam

Bureau of Reclamation Photo

ULY 1946

This Issue:

ESSAGE FROM
HE PRESIDENT

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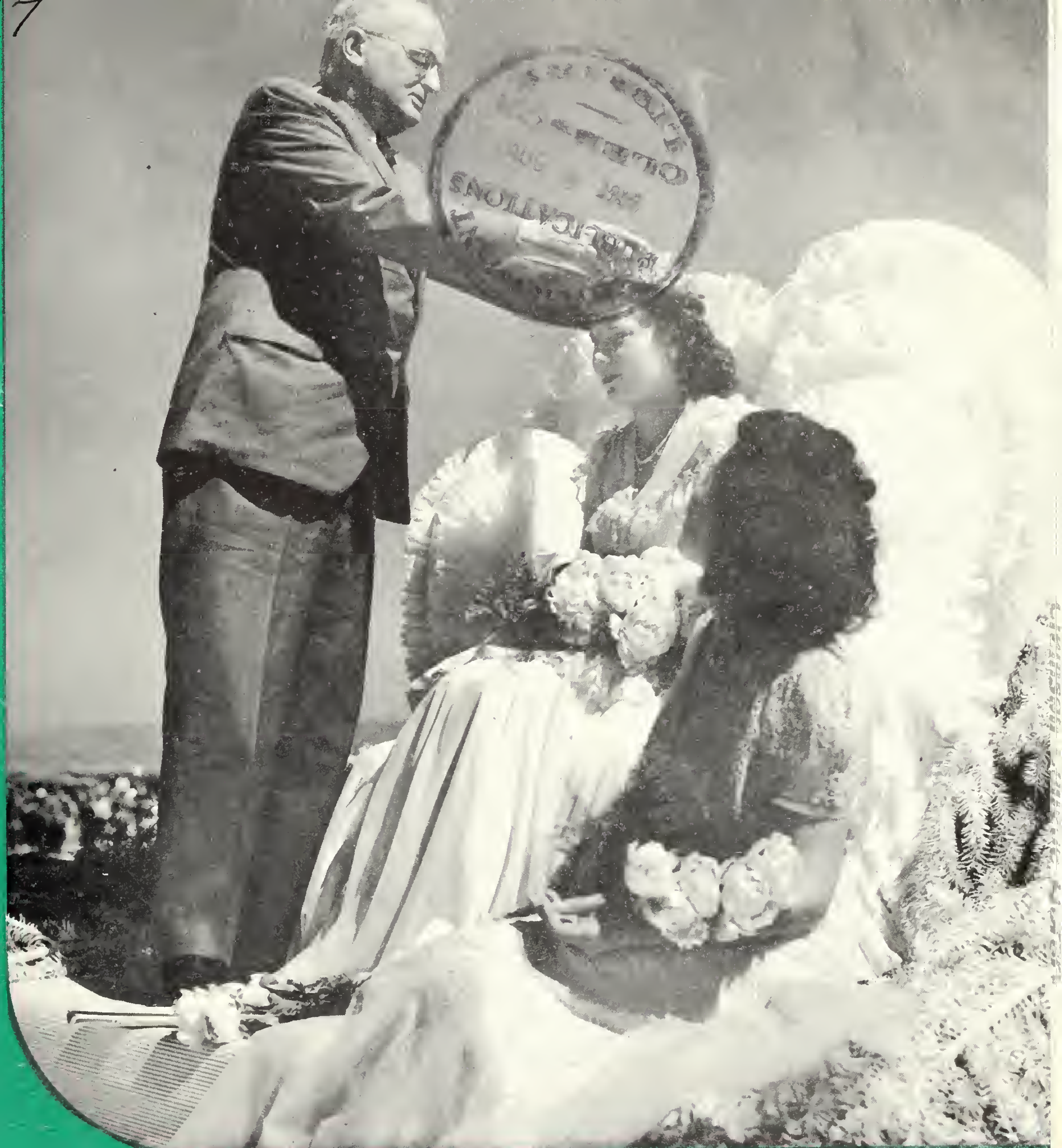

THE *Reclamation* ERA

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Contents

Front cover photograph by Frank B. Pomeroy, Chief, Photographic Section, Region I, Bureau of Reclamation. Back cover photograph by William S. Russell, Boulder Canyon Project Photographer

Lest We Forget

"Our own objectives are clear; the objective of smashing the militarism imposed by war lords upon the enslaved peoples—the objective of liberating the subjugated nations—the objective of establishing and securing . . . FREEDOM FROM WANT . . . everywhere in the world."

Franklin D Roosevelt

THE WHITE HOUSE
WASHINGTON

July 1, 1946

To All Irrigation Farmers:

In view of the terrible famine conditions faced by hundreds of millions of people throughout the world and the efforts being made by the national Government and by people of good will everywhere to alleviate this suffering, I am making a special appeal to farmers on irrigation projects served by the Bureau of Reclamation.

In one way or another, all of the nourishing food which can be produced will be utilized, either to feed our own people, who in many ways are attempting to aid their brethren abroad, or through direct shipments to distressed areas. The degree to which starvation can be averted will greatly affect the future foreign relations of this Nation, as well as the cultural status of many other countries. If it were possible for the United States to live in complete isolation from the rest of the world, this might make comparatively little difference to some people. But since modern science and technology have made the world one great neighborhood, we can not, even from an entirely selfish viewpoint, neglect the welfare of other nations without suffering deeply ourselves.

I, therefore, call upon every farmer on a Reclamation project to produce nourishing food in as great abundance as his land and equipment will permit, until dire famine conditions in other parts of the world have been alleviated. It may be several years before we can relax our efforts to avert famine in many lands, and the evils which follow it.

Harry Truman

MACHINES *Against* MESQUITE

Successful Fight Against Thorn-like Weeds

Revolutionary methods of eradicating mesquite and leveling lands are being used by the Bureau of Reclamation on the Tucumcari, N. Mex., irrigation project, now under construction. Several thousand acres of grazing land are being put into cultivation this year.

Heavy machinery—several types of which are coming into greater use in south Texas—is making possible clearing of mesquite and leveling of the land for about $40 an acre, or half the cost of the old hand methods. Earlier profitable production—and a break for marginal lands on which preparation costs are forbidding—has been the result.

The all-thorn mesquite, according to Mexican belief, was woven into Christ's crown of thorns. As a result, goes the legend, it has been shunned ever since by all birds of the air save one—the butcher bird, who alone dares use it for a landing base.

Mesquite Costly to Ranchers

The all-thorn mesquite is but one of a great many varieties of this brush, all of which have been thorns in the side of cattlemen, vaqueros, and farmers since the days of first settlement in the Southwest. Only bank robbers, horse thieves, and similar fugitives from law and order, who were wont to penetrate the brush until their trails grew cold, have spoken very kindly of mesquite.

Mesquite-infested lands can carry less cattle than those lands which are not infested, hence ranchers have fought the thickets as they formerly fought rustlers. Farmers who break ground on which mesquite has a stand know of the great cost of land clearing operations. Drought does not affect mesquite. The drier the spring, the heavier the mesquite bean crop will be in late summer.

For many years Southwestern ranchers and farmers have been experimenting and using different methods and devices for clearing their pastures and lands being prepared for cultivation. Hand-clearing operations are costly. The plant re-sprouts quickly if roots are left in the ground.

Kerosene will kill mesquite, but this method requires experimentation to avoid the use of too much or too little of it. Penetration depends upon the kind of soil, the moisture content, and, possibly, the temperature at the time of application. Even if the kerosene treatment is successful and the tree dies, it still has to be hacked down and burned. This, too, is costly.

Root Cutter Developed

On the Tucumcari project, the Bureau of Reclamation has been showing the folks how mesquite can be cleared most satisfactorily, with great dispatch and at the same time breaking and leveling new ground for cultivation.

A type of root-cutting machine designed and developed on the King ranch at Kingsville, Tex., in cooperation with a manufacturer of heavy machinery, is being used. The root cutter reportedly has doubled the ranch's carrying capacity of cattle.

Excellent results have been achieved with a La Plante Choate, hydraulically operated, flat V type, pull plow. The plow, or cutter blade, makes a swath 8 feet 6 inches wide, and cuts off the mesquite roots far enough beneath the surface so that they do not sprout. A "caterpillar" track-type tractor, model D–8, is used for power. The root-cutting apparatus is pulled by an axle mounted on the track frame of the tractor.

Wind Erosion Curbed

The cutter blade slices beneath the ground surface and does not overturn the natural grass sod, a factor which helps prevent wind erosion. After the mesquite roots have been severed, the operator attaches a rake behind the tractor and piles the brush for burning. If the land is to be planted to crops, it can later be plowed lightly or disked preparatory to seeding. La Plante Choate makes a disk with special slots. The slots catch the few remaining mesquite roots and bring them to the surface of the ground.

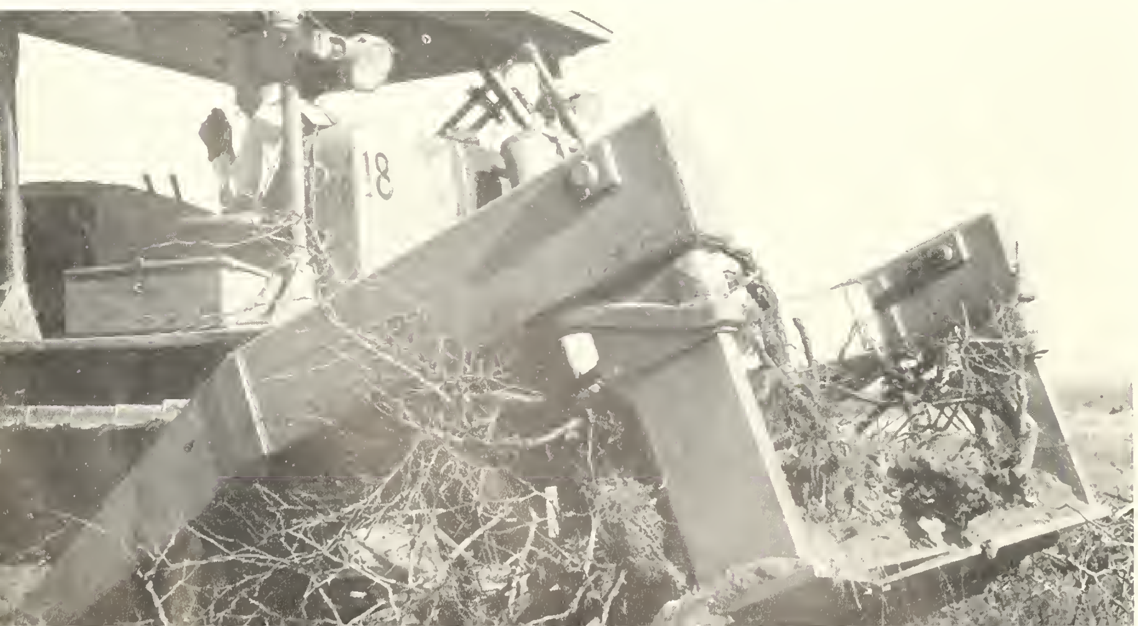
Cost of the root-cutting operation averages about $10 an acre. The land which is being cleared is to be irrigated with facilities being constructed by the Bureau of Reclamation. One root cutter will successfully clear an acre per hour of heavily infested land.

Several thousand acres of Tucumcari are infested with a medium to heavy growth of mesquite. The soil ranges from a sandy clay loam to a heavy clay topsoil, with some patches of rocks.

Sod Protected

If the mesquite infested area is to be left in pasture the sod is not damaged by the root-cutting machine as the blade runs under the ground and lets the sod fall back in place. The soil is not turned and the sod is undamaged.

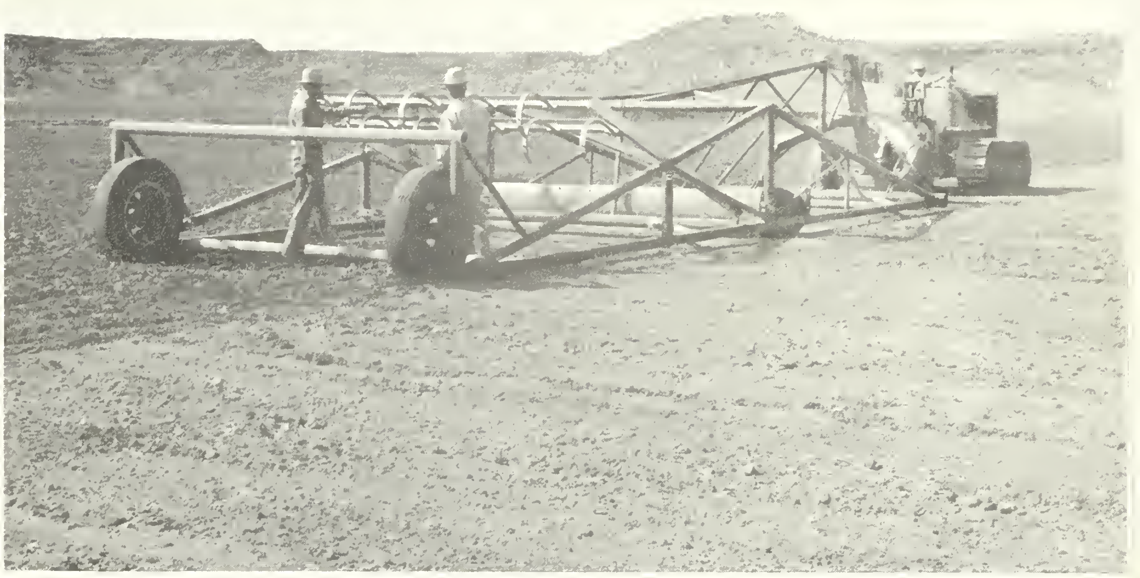
ROOT RIPPER—*This big blade moves 12 to 16 inches beneath the ground surface to shear mesquite on the Tucumcari, N. Mex., project of the Bureau of Reclamation. One operation permanently clears the land. Grass sod is not damaged. One machine can clear about an acre an hour at a cost of approximately $10.*



However, if the land is to be cultivated the mesquite roots must be raked and burned, which often leaves holes 2 and 3 feet deep. These holes must be filled and the land leveled if even penetration of irrigation water is to be obtained. This does not worry the Tucumcari project as it has licked this problem also.

A new-type land plane has been designed and built. In two operations it performs a complete job of leveling and preparing rough land for irrigation.

R. C. Higley, a contractor employed by farmers in the project area to level lands preparatory to receiving their first irrigation water, saw the need for an inexpensive method for filling-in the holes left by the removal of mesquite roots and for leveling a majority of the native pasture lands. His inspection of land levelers available to him led him to believe that he could design and build one which would be more economical and more satisfactory on the recently mesquite-infested, unusually rough land.



LAND PREPARER—*The Highley land plane, designed and constructed by a contractor on the Tucumcari, N. Mex., project under construction by the Bureau of Reclamation, is said to reduce the cost of preparing land for irrigation and for leveling land on older irrigation projects. The designer-builder believes also that it will be useful to dryland farmers as a moisture-conservation device. Photo shows workmen inspecting chisels mounted just behind the plane's cutting blade. The chisels are lowered during the second and final operation of the plane to furrow the soil as a protection against wind erosion.*

Land Plane Described

The Higley land plane is of rigid frame construction, 50 feet long, 12 feet wide, and made of 4-inch pipe tubing, electrically welded. The frame is 29 feet from the front wheels to the cutting edge on the moldboard, and 21 feet from the blade to the rear wheels. The moldboard is 12 feet wide, with 6-foot wings on each end. This results in a bottomless scraper. The dirt, cut by a curved blade, is contained in the bottomless scraper, which has a capacity of 6 yards, until it reaches a depression in the land where it is deposited. The 22-inch-high blade cuts and propels the earth in a rolling action.

The frame is mounted on the wheels by three-point suspension. The rear wheels are mounted just inside the frame, and the front of the frame rests in the center of the front axle. Both front and rear axles carry the frame 4 inches from the ground. When a wheel drops in a depression, the frame skids, thus preventing the blade from biting off more than it can chew. The blade is set for 4 inches, and maintains this depth at all times.

The 6,000-pound machine is drawn by a crawler type, 70 horsepower Diesel tractor.

On land being prepared for irrigation, the plane is drawn across the ground to level it, then again at right angles to the original direction. A chiseling tool attachment, mounted just back of the cutting edge, is lowered for the second operation. This leaves neat furrows in the newly prepared soil.

The front end of the plane can be elevated 28 inches off the ground by an automatic power lift which is controlled by the seated tractor driver.

Average cost of a finished land leveling and chiseling job is $6 per acre. The machine finishes from 20 to 40 acres of land in a 10-hour day. Maximum coverage is made on land not previously heavily infested with mesquite.

Along the Ledo Road to China, in the jungles of Africa, on the beaches of France, in the frozen wastes of the Aleutians, in the desert sands of "out yonder," America's earth-moving, land-clearing, and land-leveling machinery opened new trails to victory. Closer home, in the brush country along the Rio Grande and in the ranch country of the West, the present machine age spells doom to the refuge of early-day outlaws, long-horn steers, and rattlesnakes. Mechanically cleared and leveled mesquite lands will enable ranchers to grow more steaks and provide farmers with a more economical method to rid their farms of mesquite. And for good.

India Studies Reclamation

Six foreign engineers are reporting for work every morning at the Denver office of the Bureau of Reclamation, work regular hours, and receive no pay for it. They are G. S. Romaswamy, Bhubaneshwar Behera, Ali Ahmed Jamaluddin, T. T. Shenoy, Asrar Ahmad Qureshy, and Mubashir Hasan. All are from India, and have been doing graduate work at American universities.

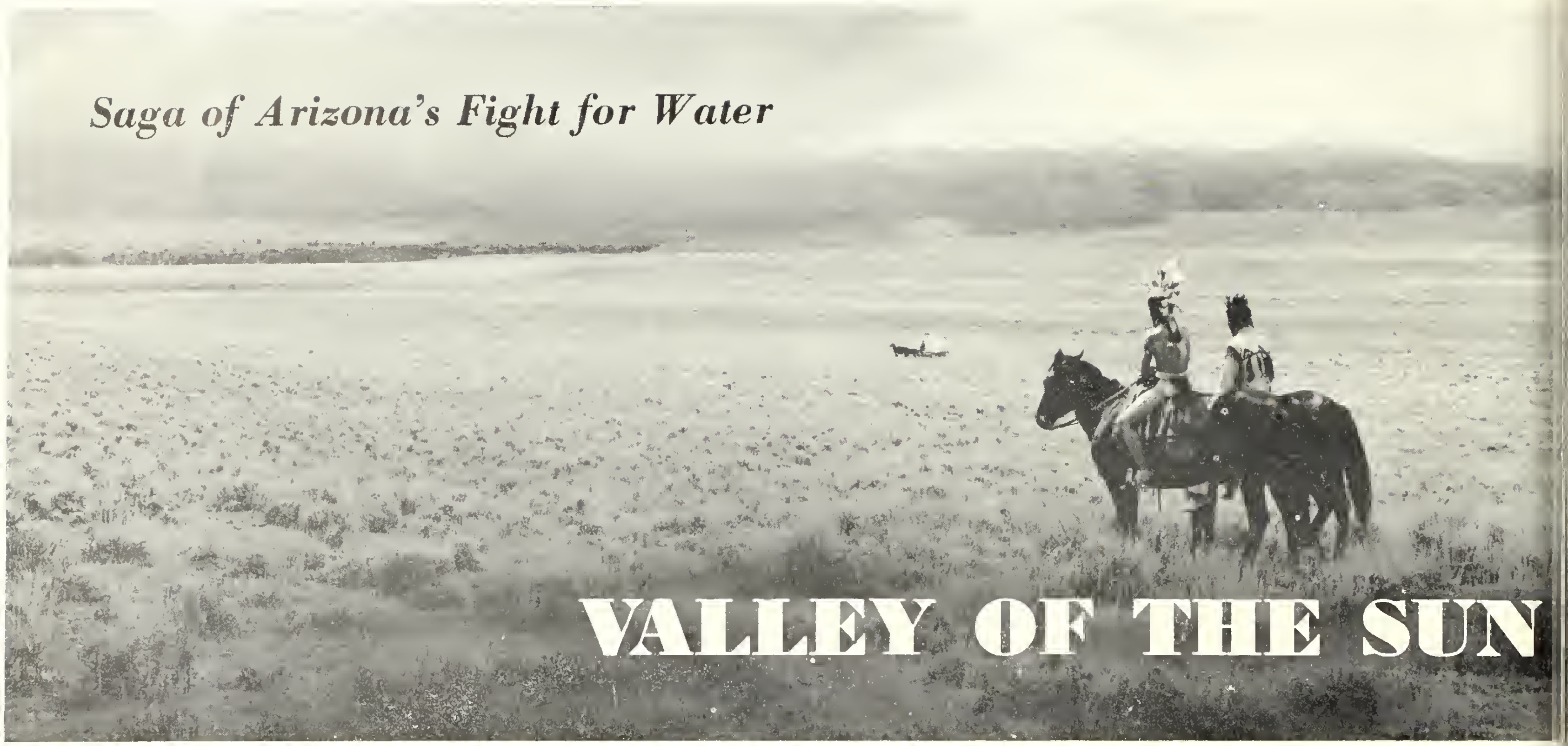
The engineers came to the Bureau through requests from the Scientific and Cultural Cooperation Division of the Department of State. Professor M. S. Sundaram, educational liaison officer of the Agent General's Office for India, urged that they be assigned to regular jobs where they would work full time and gain the maximum experience in observing Bureau methods.

Our Front Cover

IRRIGATED FARM LANDS ***of the Bureau of Reclamation's Deschutes project in Oregon make up the realm of Miss Evelyn Kelley, of Madras, who here is crowned as "Queen of Irrigation" by Goodrich W. Lineweaver, Director of the Bureau's Branch of Operation and Maintenance. Delivery of water to the parched wheat lands of this project means, in the words of Secretary of the Interior J. A. Krug, "prosperous settlement and full production" for this 50,000-acre area, of which 20,000 acres will be irrigated this year.***

(See pages 152 and 153)

Saga of Arizona's Fight for Water



VALLEY OF THE SUN

By JONREED LAURITZEN

Author of "Arrows Into the Sun"

***And a river went out of Eden to water that garden,* Genesis 11:10**

FOUR thousand years ago, maybe centuries before that, the Egyptians were flooding their lands with the waters of the Nile, and because of the stability and assurance of harvest that came from this labor they were able to weave the fabric of an immortal culture. So it was in India and China, where the civilization of mankind had its beginnings. Wherever sun and land were brought together with water there arose cities, security, arts, sciences, philosophy, a new religious concept, and a grace of living that can come only where there is no constant fear and no recurring catastrophe.

The first Spanish explorers came into the "valley of Mexico and the Aztec capital, and they were enraptured by the lovely panorama: green meadows, golden fields, blossoming gardens; while crossing in every direction like beautiful silver lace work, the numerous water courses flashed back the bright rays of the sun."

Here Reclamation Era *presents the first in a two-part story of the coming of irrigation to Arizona. Mr. Lauritzen, a native of Richfield, Utah, was born in 1902, the year in which President Theodore Roosevelt signed the act under which the Bureau of Reclamation was established. The author grew up on Reclamation projects, and his early years were filled with talk of water and land, and of the difficulties in bring the two together. To his inherited self-respect for the importance of water on the West's semi-arid lands, Mr. Lauritzen has added wide knowledge of the problems involved.*

Hohokam—700–1400 A. D.

And in the Valley of the Sun which is now Arizona there were a people known as the Hohokam, "the people who are gone." With stone hoes they cut away the roots of the saguaro and mesquite and loosened the pebbly sands, and in their hands and in baskets they hollowed canals and built high banks to hold the water until it should be set loose upon the land. They carried great stones and the brush they cleared from their land, and piled this rubble across the rivers when the waters were low, and sent the water gleaming over the sun-drenched plains. Out of soil came the melons and squash and corn they had planted. Knowing that the water would bring harvest, they built pueblos by the land, and thick-walled granaries to hold the corn.

For several hundred years their pueblos followed the ribbons of water in their canals over the valley. They made pottery, and wove cloth from cotton and yucca fiber and painted it with the pigments they found in the bright hills and mountains around them. There were centuries of generations born, learning to live and work and make a simple beauty and happiness together. But there were difficulties. The same benign waters that had brought them security finally brought them trouble. The water table rose, saturated the land, poisoned it with salt residues. With infinite patience and labor the Hohokam gouged out new canals on new levels, until they could go no further. Perhaps drought dried up the rivers, until there was not water to reach the land on the far stretches. Maybe the predatory

THE OLD WEST—*"This was no time of ease and luxury . . ."*

hunter tribes came out of the hills and took their corn and their women and there was no adequate defense against them. It might have been that disease spread among their crowded villages. Whatever the cause, the Hohokam were not even a memory when the Spanish explorers came to this continent.

There is reason to believe that the Hohokam migrated into other regions, that their exodus was sudden, for excavations disclose skeletons of babies and aged ones, indicating that the refugees were forced to leave the ones who were too young to stand the long journeys. And the graves of these were shallow; evidence that they were dug by the infirm or by people in great haste.

Endings and Beginnings

When the Spaniards came to Arizona in 1539 they found a people and a way of life much like that of the Hohokam, perhaps a continuation of it. The Yaquis, Pimas, and Maricopas were irrigating their lands by means of canals. They lived in villages, of houses made of adobe, surrounding a larger structure, a fortress with loopholes, where they might fight off invaders from the hills. In the hours when they did not till the soil they devoted themselves to making pottery of pleasing designs, and clothes of cotton and prepared skins. They were large and handsome people, and in their fine white blankets, over which streamed their long, luxuriant hair, they were a sight to see.

There was another people living farther north, the Moquis (Hopis), who cultivated corn in little patches along the Colorado Chiquita and the Rio Verde, where water could be handily taken out. And they had vineyards of excellent grapes, and walnut groves, and little fields of flax. Out of the flax they wove the aprons with tassels, and the ritual clothes they wore. They stored up the pine nuts they brought from the hills. And from the mountains beyond their brightly colored cliffs they took bear, puma, otter, wildcats, deer, for the skins and meat. They dressed the hides and made fine robes and ceremonial clothes, and from the feathers of birds they made shimmering robes. They built houses of mud and adobe and stone, with rooms tier on tier on the clifftops, with always the kiva (the estufa, the courtyard, the hot rooms) for communal use. And they had time out of all this to make fine pottery of graceful shape and paint it in rhythmic patterns of their own devising. And there was still time for the ceremonial dances and chants to please the gods of wind and rain and rivers and all the manifestations of nature. Each morning the inhabitants would gather in the "galleries," while from the highest rooftop the "priest" would chant a prayer to the rising sun. Even a devout Spaniard, Christian, admitted in those early times that "there is no drunkenness among them, nor sodomy nor sacrifice, neither do they eat human flesh or steal, but they are usually at work." Here were people who knew the grace of living in harmony with the earth; here was civilization in its finest sense.

Pioneers in the Valley

There was a man, Jack Swilling, a big, rangy, red-headed Confederate veteran who had been a successful prospector and freightor in an Apache country where handling guns well enough to survive was success. He worked at freighting for a man named Smith, who was hauling supplies to the Army post at Fort McDowell. But he soon got tired of killing Apaches, chewing road dust, listening to the jangle of the harness rings, paying 5 to 7 cents a mile toll on the roads he had to travel. The Army was paying $8.50 per hundredweight for flour and for other provisions in proportion. Even the Pima Indian farmers were making good money selling grain and hay to the post, and to the mines by Wickenburg.

This wide smooth valley of the Salt River, bordered by sharp and venomous-looking hills, did not appear too lush to a man who had been brought up in the moist bottomlands and forested swells of the South. The temperature could, and often did, reach as high as 120° F. One had to pinch himself down to the size of a saguaro to get in the shade, and in all the valley there was nary a growing thing a man could scratch his back on without getting it full of spines or thorns. But there was a river, and there were traces of ancient canals, and what could be done once could be done again. So Swilling persuaded Bryan Phillip Darrel Duppa, an English adventurer and remittance man, and two other partners to form a canal company. They capitalized at $10,000 with a plan to irrigate 4,000 acres, and their operating capital was about $400 worth of tools, equipment, and "odd coins." They began work on their first ditch, and after a month of backbreaking labor with pick and shovel were stopped by an outcropping of bedrock. They chose another site which closely followed the line of an ancient canal of the Hohokam.

They needed supplies. They sat down to compose a letter to the merchant in Prescott. Duppa, scholar and gentleman, was to do the writing. He looked up, the charcoal poised over the paper. He said, "The letter is destined for Prescott, my friends, but *whence* does it come? We have no name for this place."

"Let's call it Salina," a partner, Starar, suggested.

"Dadblast it! We don't want people callin' this 'salt flats.' Let's call it Stonewall," the Confederate Swilling said.

"Stonewall!" Starar mocked, his tone a goading lash.

"Duppa, you're a-writin' it, you name it," retorted Swilling.

Duppa considered. "Well, gentlemen, I've been thinking. If our plans work out there will be a town here, and it will be built on the ruins of towns that have been here before. I'm thinking of the young Phoenix which rose out of the ashes of the old. In the same way, we will build a new town on the ruins of one forgotten. I suggest the name Phoenix."

Starar and Swilling nodded and grunted and the name *Phoenix* was written at the head of the list of supplies.

THE NEW WEST—*"But there were the benign winters, and here lay and will always lie the true gold of Arizona's economic history. The rivers are full-bellied from the snows that lay in the mountains: but they are gentle rivers, steady and tractible, calculable." Roosevelt Dam is the key structure in Reclamation's work to help Arizona reap its heritage.*

Battle Against the Elements

Swilling was restless, a man of great energy. He cleared the saguaro and cactus and ocotillo and paloverde from 160 acres of land with his own strong hands. He built a great adobe house by his ditch.

For a few years he grew crops. He worked to get a post office established, a new county created. He brought in a man, W. B. Hellings, to build a flour mill in the valley. Only a mound of rubble shows where the Swilling house was built, but there is a bronze tablet on the fountain in front of the courthouse "to Jack Swilling and his wife Trinidad." It was his shovel and Darrel Duppa's mind that began the long march of green into the domain of the saguaro.

In 1867 the population of Arizona Territory was 6,500. This was no time of ease and luxury. These people were all muscle and bone and determination and a good gunsight eye. They got prices for what they grew, at a cost not measured in dollars and cents, but in sweat and pain and hunger and anger and death. Men farmed with one hand holding the plow, the other holding a gun. It was still a country of the Apaches, meanest varmints or bravest warriors on earth, depending on your point of view. The early corn and wheat would deepen on the land, the summer would come. Then sudden storms with their flash floods would tear out the dams of rock and brush in the rivers, pouring tons of sand and gravel into the canals. While the farmers worked to rebuild the dams and clean out the canals the heat would come and wither the growing crops. When the dams were in and the canals ready for the water, the best of the water would be gone, and too often there would not be enough in the rivers to save the crops.

But there were the benign winters, and here lay and will always lie the true gold of Arizona's economic history. In winter there is no burning sun, no sudden storms, no ripping flash floods. When rain comes it comes gently and trickles into the soil. The rivers are full-bellied from the snows that lay in the mountains; but they are gentle rivers, steady and tractable, calculable. But in winter the rivers and creeks carried more water than was needed, and the good of them went down through the Gila and the Colorado and sloshed mud into the Gulf. When the summer heat and dryness came, people remembered the swollen streams that had carried riches down to the ungrateful sea. They began to think about places where some of it could be put away. It was this thinking that eventually saved their farms and towns from going the way of the towns of the Hohokam.

Canals Offer New Hope

It took a long time for thinking to give place to concerted action. It always does when the action needs the force of many minds and hands working together. People were coming in all the time, forming companies, making new canals, opening up new lands. They were people of many kinds—mostly the kind who work best alone, without help, without interference. They had come here, many of them, to get away from interferences and restraints. It took them a long time to learn to work together even where there was dire need of it, as in this matter of water storage.

Confederate veterans came, joshing each other about coming out to Hell's fire valley to get away from taking the oath of allegiance. Miners, tired of pick and shovel and hard tack, stopped off and put pick and shovel to building canals so that they could eat green stuff and get the ready-dug gold of the Army posts. Gold hunters on their way to California, or back, stopped off, drawn by this spectacle of figs growing in the shadows of the tall saguaro, and Mormons building a church in a field of barley. They came from everywhere and they were of every kind. They were the same as any other people from anywhere in America.

The homestead law, which allowed a citizen 160 acres after 5 years of residence and the making of improvements, hastened settlement of the Salt River Valley. It particularly encouraged veterans of the Civil War, who were given credit on their homesteads for the time they had been in service.

Mormons came in from the north. Caravans of them. They knew the alchemy of mixing land and mountain water. They had learned it since those first grim days of '47 in the valley of the Great Salt Lake. And they had learned to work together, as they prayed and sang together. Maybe the others learned something from them. Maybe it was only the beating of stark necessity that taught them.

In every group of pioneers there are some who work with their brains as with their body, and usually the contribution they make to the mental and cultural growth of a community is greater, though less measurable, than any work they might have done with their hands. Such a man was Capt. W. A. Hancock, who surveyed the first townsite, many of the ditches. He became sheriff. He was one of the first to see the necessity for water storage and one of those to initiate the long struggle for stability and security in the valley through the building of reservoirs. Another leader was John T. Alsap, who became the first probate judge of Maricopa County, and found plenty to do on the side as legal counsel to the various canal companies as they were formed.

As people moved in, new canal companies were being formed each year, until by 1880 there were a hundred thousand acres under cultivation in the Valley of the Sun. There was enough water for everybody, with plenty going to waste in the winter.

The distribution of the water had become systematized. From the canals which followed the imperceptible slope of the land, the water was taken out through weirs, and measured into the ditches of the individual farmers by the watermasters and zanjeros, "one who opens ditches." Each farmer put in his share of the maintenance and distribution cost, and if he did not grow enough on his land to pay it, he had his ditch tax to pay nevertheless.

There was plenty of water those years, and nobody paid much attention to men like Hancock and their talk of water storage. Some thought it was simply a trick idea to store up the water for the use of the original settlers when the rivers got low, and to deprive the later comers of their share. Some bitterly opposed the idea of reservoirs altogether.

The Droughts Come

Then in 1887 a thing began to happen that made even these people begin to wonder. Through most of the winter the skies had been clear over the mountains east and north and south which mothered the Aqua Fria, the Verde, the Salt, the Gila, the Hassayampa. The rivers did not rise, the creeks did not come alive. With spring came not rain but heat and dust. Dust rose up from parched and barren fields, from grain fields browned, dying in the sun, whipped around the trunks of trees whose leaves were withered before they could turn green. Dust filtered through the cracks in houses, through door and window frames, and tent flaps, and into dugouts, gritting food and mouths and eyes, and whetting tempers. Some men fought with fists or shovels or guns or vituperation over the little water there was. Others packed their goods in the wagons, turned gaunt faces west, east, north, and rumbled away. Some left the fruit of 20 years' labor. Here was something they hadn't calculated to meet, something they couldn't lick, and they might as well go first as last to a place where there was rain. Others turned their livestock loose in the river bottoms and went to sit in front of the store or the post office, stare at the sky and talk about rain. Nobody paid much attention to violent articles printed by the *Arizona Republican* against the selfish ones who had opposed past efforts of the community to create storage facilities. There wasn't much anybody could do but wait and see if it would ever rain again. Some listened to a few who orated about dams and reservoirs, but "Dangblast it! You can't git people together for anything but a barn dance, hereabouts."

There were hard-willed ones who would refuse to sit and wait for the weather to come sevens and elevens while the paloverde marched in and took back their land. They had licked Apaches and Comanches and distance and weather and a lot of other difficulties before. They would lick this drought.

NEXT MONTH

Part II—Irrigation Builds an Empire on Drought-Seared Arizona Acres

Boy Scouts arrive by barge to take over their new camp on the banks of Shasta waters.

Vacation Land in the Making

If you are a resident of California's great Central Valley, there's a new vacation land in the making that will appeal to you. Or, if you're one of the thousands of Americans planning to combine open-air relaxation with sightseeing, you can put the Central Valley on your list of places to visit.

The million and a half residents of this 500-mile long, 120-mile wide, mountain-ringed basin have had to go far afield for much of their outdoor recreation. Precious waters of their Sacramento and San Joaquin Rivers, diverted into the fertile but parched fields, offered little for recreational use. But the same dams that now are providing irrigation and flood control, generating power, and aiding navigation, also are giving man pleasure as well as sustenance.

A taste of the recreational opportunities ahead for thousands of valley folk and sightseers was given to Boy Scouts early this summer when 600 acres of Government land on the southern shore of the Pit River arm of Shasta Lake were dedicated as a permanent camp for Boy Scouts and Sea Scouts.

Only 3 dams of the 50 proposed in the complete Bureau of Reclamation's Central Valley plan have been completed, but the plan already is making a big difference in outdoor life in the valley. It has created, behind Shasta Dam, 25-mile long Lake Shasta. Behind Friant Dam, it has formed Millerton Lake, 16 miles long.

These two bodies of water, at opposite ends of the long valley, brought pleasure to thousands even before they were officially opened to the public. The recreation-starved residents of the valley descended upon them with boats, fishing tackle, and sunbathing attire. Now that plans for the recreational utilization of the reservoirs have been formally handed over to the management of the National Park Service, use of the lakes will increase.

Outdoor recreation dependent upon water until recently was beyond the reach of all in Central Valley except those with the time and money to take long vacations involving travel and expensive overnight accommodations. The Central Valley project is making an ever bigger change in this unhappy situation. The complete Central Valley project, damming the mountain streams to store irrigation water and control floods, would create 300,000 acres of water surface which could be used for boating, swimming, fishing, and shoreline picnicing.

Some valley residents would have as many as 7 lakes within an hour's driving distance, or as many as 17 lakes less than 2 hours' away. Every valley city would have at least one body of water within easy travel distance.

It will be many years before all the dams of the Central Valley project are built. However, as many as 13 more are on the urgent list by 1960 and will take their place with Shasta and Friant Dams as the source of a whole new leisure-time life for the growing population of one of the Nation's most important agricultural regions.

STREAM FISHING IMPROVED—*Through the control of floods and the regulation of water released into flowing streams, reclamation dams improve fishing conditions.*

Columbia Basin Program *Speeded*

Settlement Opportunities for 5,000 by 1950–51 Set as Bureau of Reclamation's Goal

Settlement opportunities on 100,000 acres of fertile land in the Columbia Basin of Washington State will be provided by 1950–51, under the Bureau of Reclamation program for development of that project.

This program, dependent upon availability of construction funds, is 10 to 15 years earlier than that set in prewar days. It was scheduled in order to offer farming opportunities to families of 5,000 veterans and others as quickly as possible.

Construction of one of the world's largest

H. A. PARKER . . . *heads irrigation staff.*

single irrigation enterprises is being rushed to provide jobs for war veterans, to meet the demand of veterans and others for irrigated farms, and to enable the Pacific Northwest's agricultural expansion to keep pace with its industrial development and greatly increased population.

The mammoth irrigation system, with its "Paul Bunyan" pumps, four big dams, and 1,000 miles of canals, siphons and tunnels, will cost an estimated $300,000,000 and will require 125,000,000 man-hours of on-site labor—double that used in building Grand Coulee Dam, world's largest concrete structure and key feature of the Columbia Basin project. An estimated 135,000,000 tons of earth and rock must be handled.

Ultimately 1,000,000 acres are to be irrigated by the Columbia Basin project.

15,000 New Farm Homes

About 15,000 family-size farms which will be created when the entire area is irrigated offer one of the best opportunities left for a war veteran to obtain good land at a low price. Already more than 100 applications are coming in weekly from veterans.

Contracts totaling approximately $175,000,000 are to be in operation in the next 2 years. The Bureau had $30,000,000 for the fiscal year just ended and has requested appropriations of $75,000,000 for each of the fiscal years 1948 and 1949.

Ephrata, seat of Grant County, 50 miles south of Grand Coulee Dam, on the northern edge of the project, was designated headquarters of the irrigation phase of the Reclamation program. A three-story administration building, storage and repair facilities, and a concrete-testing laboratory will be constructed there. A headquarters staff of 300 will be organized under direction of H. A. Parker, irrigation engineer. W. W. Johnston, former assistant regional director at Boise, Idaho, has established offices at Ephrata as project development supervisor to direct the land-development and settlement programs.

Most of the initial acreage to be developed by 1950–51 is in the Quincy and East Districts, in the northern half of the project. In the South District, about 6,000 acres will be under irrigation by the end of next year, using water pumped directly from the nearby Columbia River. The pumping plant, which will be on the east bank of the Columbia about 12 miles northwest of Pasco, will be salvaged when water from the main irrigation system reaches the area.

Coulee Work Under Way

Bureau of Reclamation employees at Grand Coulee Dam are working on the pumping plant and the feeder canal to the 27-mile long equalizing reservoir, which is to be formed by two earth-and-rock dams in the Grand Coulee, prehistoric diversion channel of the Columbia River.

The pumping plant will house the largest pumps yet designed. They will be turned by the world's most powerful electric motors, each rated at 65,000 horsepower. Installation of the first of the pumps, which will lift water from Lake Roosevelt (behind Grand Coulee Dam) 280 feet to the feeder canal, is planned for the fall of 1948. The concrete-lined 1.6-mile long feeder canal will have a capacity of 120,000 gallons of water per second.

Private contractors are expected to hire about 2,000 men on preliminary construction work this year, and to step up employment as funds are provided. Plans call for early work on the following major structures in the irrigation system.

Four or six of the Coulee Dam pumps; the earth-and-rockfill South Dam across the Grand Coulee, 10,000 feet long, 65 feet high, and 450 feet wide at base; about 25 miles of the Main Canal, including a 10,000-foot tunnel through solid rock and a 1,000-foot siphon; the Long Lake Dam, 1,650 feet long and 100 feet high, which will save several miles of costly canal construction by permitting use of natural channels; the Potholes Dam, nearly 3 miles long and 110 feet high, which will be built near the center of the project to capture and reuse seepage water from irrigated lands north of it; parts of the 88-mile west canal and the 130-mile east low canal; and the Paseo pumping plant and lateral system.

One of the biggest jobs of the Bureau is informing prospective settlers that the Columbia Basin project, despite the gigantic scale of construction work, will not be ready for settlers, except in the small area near Pasco, until 1950 or 1951.

VISUALIZES ENGINEERS' PLANS—*John MacGilchrist, Reclamation artist at Denver, is completing his conception of the proposed Central Utah project, which would provide 600,000 acre-feet of water annually from the Colorado River Basin for irrigation and power. Mr. MacGilchrist used three-point perspective before it was popularized in text books.*

Return of the HOMESTEADER

250 Veterans Soon to Get Their Chance to Farm on Irrigated Public Lands

Registered letters carrying opportunity to obtain a stake in the land for which they fought will go out to approximately 250 veterans of World War II during the next 4 months.

The letters will contain notices of the award of homestead farm units by the Bureau of Reclamation on four projects on which public lands are being opened to entry this year. These are the first homestead opportunities offered by the Bureau since before the war.

The opening of these lands is but a drop in the bucket, figuratively speaking, to the demand for settlement opportunities which exists among the veterans. Bureau of Reclamation offices have been flooded with thousands of inquiries concerning the settlement programs, more than 80 percent of them from veterans.

The Bureau expects to meet this demand with a steadily expanding settlement program which, by the end of next year, will provide 1,158 farm units on public lands and 3,615 units on private lands. The 1950–51 goal, which is contingent upon funds being provided by Congress, is 4,496 farm units available through homesteading on public lands, and 42,208 farm units receiving initial irrigation service on private lands.

A total of 21,254 acres of public lands will be opened to entry on Reclamation projects this year, the first of which will be 7,500 acres comprising 86 farm units on the Tule Lake division of Klamath project south of the Oregon-California state line. Public notices on the opening of these lands will go out in July with the lands to be opened for entry in August.

Other lands which will be opened this year include 1,254 acres comprising 36 farm units on the Roza division of the Yakima project in central Washington; 9,000 acres—90 farm units—on the Heart Mountain division of the Shoshone project in northern Wyoming, and 3,500 acres comprising 44 farm units on the Gooding division of Minidoka, in southern Idaho.

Veterans First

Although, technically speaking, the lands will be opened to all qualified citizens, the fact that veterans of World War II have a 90-day preference in filing makes it improbable that units will be awarded to anyone without war service. Bureau of Reclamation offices have been flooded with inquiries concerning the settlement program and more than 90 percent of the letters are from veterans.

Under an act of September 27, 1944 (as amended), a person who has served or may serve in the military or naval forces of the United States for a period of at least 90 days during World War II and has been honorably discharged is granted a preference right of at least 90 days in the filing of applications for public land homesteads on Reclamation projects.

Veterans also are entitled to have their term of active service, not exceeding 2 years, deducted from the 3 years' residence requirements under the homestead laws. Veterans under 21 years of age are entitled to the same rights under the homestead law as those over 21.

Coincidental with the resumption of the Bureau's settlement program is a significant change in the procedure for selection of successful entrymen. Responsibility is placed as close to the "grass roots" as possible.

Local Boards Will Act

Department of Interior Order No. 2195, signed May 10 by Secretary J. A. Krug, provides enlarged responsibilities for local boards of examiners, particularly concerning the establishment of qualifications and method of selection of the entrymen.

Local examining boards will tailor qualifications to insure the proper agricultural background, financial resources, etc., which the entryman should have if he is to have a reasonable chance of success on the particular land for which he has made application.

The Bureau will coordinate broad policies to insure veterans' preference and maintenance of minimum qualifications necessary to insure the settler's success and

KLAMATH—*This alfalfa hay is on the Klamath project in Oregon-California, one of the first areas in which homestead lands will be opened.*

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consequent ability to repay money the Government has invested in the irrigation works serving him. Within this framework, however, the local examining board, which will be composed of a ranking project official and two or more local community representatives, will direct the settler selection program.

Four Projects Concerned

All of the lands to be opened to public entry this year are on long established and successful projects.

The Klamath project, first unit of which was constructed by the Bureau of Reclamation in 1907, is in Siskiyou and Modoc Counties, Calif., and Klamath County, Oreg. Principal crops are potatoes, grain, alfalfa, small seeds, vegetables, and pasture. The soil is Yakima sandy loam, average growing season is 130 days, annual precipitation 12.99 inches, and elevation 4,100 feet.

The Shoshone project is in the eastern foothills of the Rocky Mountains in northern Wyoming. The first unit was authorized in 1904 and the first water delivered in 1908. Most of the land is at 4,500 feet elevation, the growing season is 6 months long and rainfall averages 5.9 inches yearly. The soil is principally light sandy and clay loam. Principal crops are oats, wheat, alfalfa and other forage, beans, sugar beets, small grains, and seeds.

The Yakima project in central Washington was authorized in 1905 and the first water was delivered in 1907. Principal crops include apples and other fruits for which the area is nationally famous, wheat, alfalfa hay, pasture, potatoes, other vegetables and truck and small grains. Elevation varies sharply, ranging from 400 to 2,200 feet, and the growing season is from 5 to 7 months. Average rainfall is 7 inches on the Roza division. The soil is a sandy loam, volcanic ash, silt loam, and alluvium loam.

The Minidoka project, along the Snake River in southern Idaho, was also authorized in 1904 with storage facilities in three reservoirs, one of them Jackson Lake in the shadow of the Teton peaks in the Wyoming Rockies. Elevation of the project lands is approximately 4,150 feet and annual precipitation is 10.68 inches. The soil is sandy loam, clay loam, and disintegrated ash. Crops produced during the 6½-month average growing season include potatoes, beans, sugar beets, clover seed, alfalfa, bean seed, wheat, barley, and oats.

Some of the lands to be opened to entry this year on the Klamath, Minidoka, and Shoshone projects have been farmed during the war years by the War Relocation Authority, which maintained centers for persons of Japanese ancestry evacuated from the Pacific coast. They are in a fair state of cultivation, much advanced over the normal undeveloped public lands.

WHAT THE RECLAMATION PROGRAM MEANS

Just what does the Reclamation program offer in farming opportunities?

IMMEDIATELY

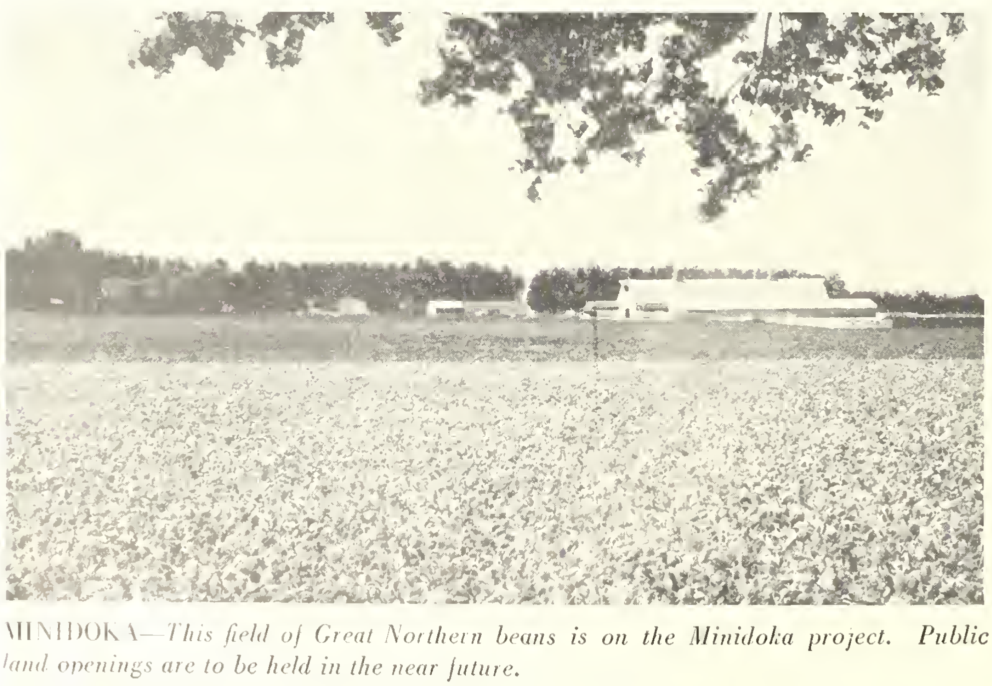
The first homesteading on irrigation lands since the prewar days of 1941 begins this summer. Public lands will be opened over a three-month period beginning about August 1 on the Klamath project, in California-Oregon; the Yakima project, in Washington; the Shoshone project, in Wyoming; and the Minidoka project, in Idaho. To receive notice of these openings when the exact dates are set, write to the project superintendent or the Regional Director. A list of Bureau offices and personnel appears on the back inside cover.

IN THE NEXT FIVE YEARS

Projects authorized by the Congress can, by 1951, accomplish the following for the Nation's agriculture:

	Create new homestead farms	*Provide initial irrigation water to private land farms*	*Give supplemental irrigation water to private land farms*
Arizona	822	975	
California	1, 199	1, 132	5, 200
Colorado		80	13, 630
Idaho	226	437	4, 687
Montana		260	125
Nebraska		75	
Nevada	226		
New Mexico		562	
Oklahoma		910	
Oregon	171*	667	
South Dakota		60	75
Texas		2, 360	2, 575
Utah		123	1, 425
Washington	827	5, 880	
Wyoming	995	327	90
Missouri Basin	(*)	28, 360	510
TOTALS	4, 466	42, 208	28, 317

*Public land (homestead) farms in the Klamath project of California-Oregon and the Owyhee project of Oregon-Idaho are listed under Oregon in this table. Some public lands are involved in the Missouri Basin developments, but they cannot be segregated at this time.



MINIDOKA—*This field of Great Northern beans is on the Minidoka project. Public land openings are to be held in the near future.*

New Promise in the Holy Land

RECLAMATION—American s t y l e—has been adopted as the tool by which arid Palestine will attain new levels of productivity.

Water in the Holy Land, as in our West, is scarce and therefore an invaluable resource. To increase the "human carrying capacity" of the land, the Jewish Agency—set up under the League of Nations mandate to cooperate in fulfilling provisions for establishment of a Jewish national home—is working on multiple-purpose projects reminiscent of Boulder Dam, Columbia Basin, Central Valley, and other great Bureau of Reclamation projects.

By using waters of the Jordan and other rivers, there would be created 96,000 new fruit, vegetable, and grain farms on which more than 412,000 persons could find homes. By putting the Dead Sea to work, Palestine would create a power resource essential to support the additional population contemplated.

The Jewish Agency has sent Solomon Grazowsky, an agricultural engineer, to this country for a year's study of Bureau of Reclamation projects. Now in the West, he plans to help apply to Palestine the progress now incorporated in American multiple-purpose engineering.

Mr. Grazowsky has prepared a report with some modifications to the "Proposed Over-all Irrigation and Hydro-Electric Development in Palestine," reported by James B. Hays, chief engineer for the Commission of Palestine Surveys, and reviewed on the ground by John L. Savage, former chief designing engineer of the Bureau.

Mr. Grazowsky explains that the projected reclamation work will irrigate the Valley of the Jordan, the Plain of Esdraelon, the Western Negev in which is Beersheba, and ultimately the Araba region, which is to the south. Two irrigation projects—a western and an eastern project—are contemplated.

For the western project, water will be drawn mainly from the upper Jordan in the Huleh Basin by a canal 200 miles long. Water will also come from seven tributary rivers, from the springs in western Galilee, from flood waters on the western slopes of the hills of Shomron and Judea, and from the local sources of the western Negev, such as floods, springs and ground water. This water will irrigate the arid Negev in south Palestine and the Plain of Esdraelon. Water will travel in a canal 60 miles long before it reaches 100,000 Esdraelon acres. An area of 300,000 acres will benefit in the Negev.

The eastern project concerns the Jordan Valley proper. Water drawn from the Jordan below Lake Tiberias, from the Yarmuk River, and from springs in the Beisan and other areas, with flood waters from the Huleh flowing into two 60-mile canals running on either side and almost parallel to the Jordan, will irrigate an area of about 130,000 acres, now mostly arid.

Under the eastern project, the course of the Yarmuk River will be changed. The Yarmuk now empties into the Jordan; it will empty into Lake Tiberias. It is a problem river, not unlike some of our rivers in the west. In summer the Yarmuk has a flow of 280 cubic feet per second. In winter, comparable to flood season here, the Yarmuk flows 60,000 cubic feet per second. There are no flood problems there, for the Yarmuk flows in a deep valley. Lake Tiberias will then serve as the reservoir in the east. It has an area of 41,000 acres, and has a total storage capacity of 520,000 acre-feet.

There also will be hydroelectric power. The American practice of combining irrigation and power, thus making the greatest use of the available water, has drawn Mr. Grazowsky to see the developments here.

There are two power projects in the plan, separated on a basis probably strange to the ears of American engineers—the fresh-water project and the salt-water project.

The salt water project, to couple the Dead Sea and the Mediterranean, would be unique in its operation. It is possible to take advantage of a power drop of 1,296 feet by dumping water from the Mediterranean into the Dead Sea.

An aqueduct system for diversion of Mediterranean water will include a canalized coastal reach of the Qishon River; a pumping plant, lifting the water about 130 feet; a canal leading to an equalizing reservoir and a 19-mile tunnel that extends through the divide near Afula on the Plain of Esdraelon; a canal leading to an equalizing reservoir on the Plain of El Buqeia; a low-pressure tunnel leading to a power plant on Abu Sidra that will discharge into a regulating pool; a canal leading southward to another regulating pool located above and opposite the north end of the Dead Sea; and a short pressure tunnel and penstocks leading to a power plant on the shore of the Dead Sea near Ein Fashkha.

In proposing to bring Mediterranean water to the Dead Sea, use of the channel of the Jordan River was avoided because of probable religious objections. The Place of Baptism is located about 4 miles north of a point where the Jordan enters the Dead Sea. This area attracts many pilgrims each year. The Palestine Government has set aside a tract of land for religious use in this area. A special low submerged dam is proposed to preserve this site.

This Mediterranean diversion will supply water to the Dead Sea equal to that diverted from the Jordan and its tributaries as required for irrigation. Thus the present level of the Dead Sea will be maintained.

It is necessary to maintain the existing level of the Dead Sea due to a concession (for producing chemicals) now held by Palestine Potash, Ltd. Engineers calculate that the annual evaporation of the Dead Sea is 1,625,000 acre-feet, or approximately 80 inches per year. (Evaporation at Lake Mead is estimated at 60 inches a year).

This power project would generate approximately 200,000 kilowatts from a flow of 1,750 second feet of water. This would give an annual output of 1,200,000,000 kilowatt-hours, of which one-third is required for pumping.

OLD WORLD MEETS THE NEW—*Solomon Grazowsky is traveling in the American West to study the Columbia Basin and other Reclamation projects. He hopes to help apply in Palestine (left) the "know-how" that has created the great United States irrigation and power developments.*

WARTIMI

Pa

First Water at Deschute Basin, Symbolic of Recla Challenge of Peace

Many residents of Jefferson County, Oreg., waited a lifetime for this irrigation water. Above, first water is delivered to George Rodman's farm.

George Rodman, at left, was the first man to receive water from the Bureau of Reclamation's Deschutes project. He lives near Culver.

Hand welding is required for preliminary "tacking" on the Salt Lake Aqueduct of the Provo River project (below left). The aqueduct will double Salt Lake City's water supply. At right, work continues on canals of the Altus project, first Bureau development in Oklahoma.

Until VJ-day it was called postwar planni Today, less than a year since, that constant pl ning and preparation for work awaiting war's already is paying off.

It paid off in Jefferson County, Oreg., in M when life-bearing water flowed onto the first i gated farm lands of the 50,000-acre Deschu Reclamation project. Five thousand peopl more than twice the county's 1940 populatio gathered to celebrate. And well they might, 1946 recorded the county's driest spring in years.

It paid off in the great Missouri Basin too, w the blast that marked the start of construction Kortes Dam. This $4,688,000 dam and po plant on the North Platte River, 60 miles fr Casper, Wyo., is the first postwar unit in Bureau's joint $2,000,000,000 Missouri Ba plan inaugurated in conjunction with the War partment's Corps of Engineers. The people th for the North Platte blast—and the thousand their fellows in all the basin States—had so thing to celebrate too.

It is paying off, too, at many places in our gr arid land stretching west from the ninety-seve meridian. At dam sites, along canal and po line routes, in the towns and cities near irriga project farms—at all those locations where m tiple-purpose projects are in the making—c struction or planning was bringing nearer the t when the promise of irrigation will be fulfille

Men at Work

Deschutes and Kortes are symbolic of w is happening in the West. Men are at wo thousands more soon will be working on dams, the canals, the power plants, and the tra mission lines that have been on the plann boards throughout the war years.

On California's Central Valley project, for i stance, new irrigation and power contracts p vide for work that will add irrigated farm la and power resources to support the boom coastal cities. In the southwest, work has sta on Davis Dam, which will join Boulder Parker Dams in bringing the Colorado fully i man's service. On Washington State's milli acre Columbia Basin project, a contract has b awarded for manufacture of 6 of the 12 pu that are to irrigate the first 400,000 acres 1950–51. These pumps, of unprecedented s

LANNING

Off

t of Work on Missouri n's Answer to the

ll be capable of the fabulous task of lifting ,000 gallons of water each second to a height 270 feet. Contract for the project's river-like in canal also has been let.

Work proceeds on the spectacular Colorado-Big ompson project. There, new contracts totaling nost $8,000,000 have been awarded for con- uction of Granby Dam, Rams Horn, and Pros- ct Mountain tunnels. Work is being speeded Oklahoma's first Reclamation project, Altus.

On all these projects and on the many others der construction or in the various blueprint ges, the Bureau has one predominating pur- se—creation of family type irrigation farms. ese projects will do other things—produce wer, aid navigation, control floods, provide nicipal water supplies, create recreational cilities—but the creation of new farms and the equate watering of present units is the guiding n

Of the nearly 200,000 farms that would be eated under the Bureau's plans for future years, ,000 would be in the Missouri Basin. It was vision of these farms—assuring a stable agri- ltural base for regions that have been victimized floods in some years and droughts in others— at gave cause for celebration over the blast that rked the start of Kortes Dam.

eterans Find Homes

Deschutes—now within easy sight of what irri- tion can do—offers the story that also belongs the other projects and to the potential projects. at May day, when the first irrigation water wed, heralded the beginning of a new era in ferson County—of growth from 2,047 in 1940 an expected 8,000 to 10,000, of 650 to 700 new igated farms, of scores of new businesses, and several million dollars in new farm income.

Even before the first water delivery, more than dozen new businesses had gone up in Madras, lver, and Metolius. About 20,000 acres of the oject's lands will be irrigated this year, the re- ining 30,000 in 1947 and 1948. Already, ap- oximately 80 veterans have found homes on e project.

"Celebrate!" explained one old timer. "Sure, y shouldn't we? I've got 160 acres here which uld grow only 15 bushels of wheat every other ar. With that water, I'll grow alfalfa the cows ll get lost in."

Mrs. I. L. Kortes (above), member of the Wyoming family for which the Kortes project is named, and Regional Director Debler, before the ceremony.

With terrific din echoing between the walls of the canyon, loose rock is blasted for start of work on the Kortes unit of the Missouri Basin plan.

Work goes forward on the multiple-purpose Columbia Basin project. At left below is the huge caisson which will be placed over the spillway bucket of Grand Coulee Dam. At right, a whirley-top gantry crane is being erected over the roadway atop the pumping plant foundation at the dam.

VALLEY LIFELINE

By WILLIAM J. WILLIAMS*

Coachella Canal Brings Colorado River Water to One-Time Desert

Today you can stand on the eastern range of hills above the Coachella Valley in Riverside County, Calif., and look down upon Colorado River water in the Coachella Canal. Under construction by the Bureau of Reclamation as a part of the All-American Canal System, this vital artery will bring new life to one of the Southwest's most potentially rich garden spots—the Coachella Valley.

Water from the All-American Canal has been turned into the 86.5-mile completed stretch of the Coachella Canal which ends at siphon No. 32, about 22 miles southeast of Indio. A pipe line from the siphon carries water 15 miles farther along, where it is being used for the construction operations under way on the next reach of the canal.

The unlined portion of the canal ends at siphon No. 32, and from that point the 58.5 miles of the remaining sections will be lined. To date over 10 miles have been lined, and work is progressing at the rate of 500 to 700 feet a day. The first unit of a system of protective works is concurrently under construction. The first few miles of lined canal will be protected from damage from storm waters collecting above the canal by a detention dike. The dike will impound and deliver these waters into a concrete-lined wasteway discharging them harmlessly into the Salton Sea.

Upon completion, the Coachella Canal and distribution system will irrigate some 75,000 acres of arable land in the valley. About 17,000 acres now are watered by pumping from wells. The agricultural expansion in the valley during the past several years, resulting in excessive pumping, has depleted the underground water supply, and farmers in the valley look to Colorado River water to sustain their thirsty fields.

About 80 percent, or 115 miles, of the 145-mile long canal is completed or under contract; and the present schedule calls for completion of the remainder by June 1948. Negotiations are under way between the Bureau of Reclamation and the Coachella Valley County Water District for a repayment contract to cover costs of constructing a distribution system to carry the water from the main canal to the fertile fields of the valley.

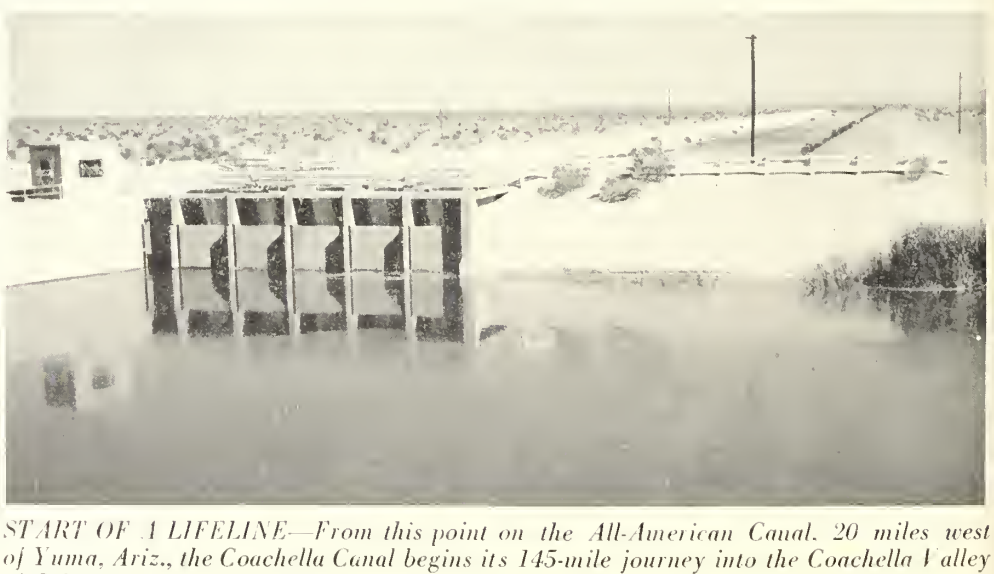
The Coachella Main Canal takes off from the All-American Canal near the Mexican border, 20 miles west of Yuma, Ariz., runs in a northwesterly direction a few miles east of the Salton sea, and eventually will make a U-turn several miles north of Indio and loop south to the Riverside County line, a few miles south of the northern shore of the sea. The canal will deliver an average of 1,350 cubic feet per second to the valley.

A repayment contract to cover costs of the main canal was approved October 15, 1934. The first construction contracts were awarded in 1938 and 1939, and 86 miles of the unlined portion of the canal were completed prior to 1943. Under contracts awarded in 1944 and 1946 to the Shea Co. and Morrison-Knudsen Co., Inc., some 29 miles of the lined portion of the canal now are under construction. Work during the war was on a limited scale.

The Coachella Valley, originally known as a part of the Colorado Desert, lies in a great trough the lower end of which is the present Gulf of California. It is a narrow area extending about 60 miles northwest from the Salton Sea to the summit of San Gorgonio Pass. Much of the valley is below sea level. Separated from Imperial Valley by the Salton Sea—which was formed in 1905–07 when the flood-swollen Colorado River swept through its banks below the Mexican border and spilled over into the Salton Sink—the Coachella Valley contains 344 square miles, or 220,160 acres. Less than 100,000 acres, however, are arable. A thousand acres of this total are in public ownership and at a future date will be opened to veterans and others for homestead entry.

Some 25,000 acres of land in the valley are either in crop or have been cleared, leveled, and prepared for crop, but only slightly over 17,000 acres are receiving water because of the critically low underground supply. When the Coachella Canal and distribution system are completed, estimates are that about 40,000 acres will be ready to receive water. During the next 10 years about 90 percent of the irrigable acreage is expected to be in crops. This expansion is expected to be rapid as most of the land is presently owned by people with the funds necessary for irrigation development.

The Coachella Valley and the broad Imperial Valley to the south of the Salton Sea form a single basin of triangular outline, which is enclosed on three sides by barren, rugged mountains. The Salton Sea is an imposing sight in this bleak desert region but unfortunately its waters are saline, unsuitable for irrigation or domestic uses. Standing as a testimony to the disaster that accompanied the early settlers' attempts to farm the Imperial Valley, the sea's only value is in the recreation it offers to the fisherman, boating enthusiast, and swimmer.



START OF A LIFELINE—From this point on the All-American Canal, 20 miles west of Yuma, Ariz., the Coachella Canal begins its 145-mile journey into the Coachella Valley of California.

* Assistant Regional Information Officer, Region III.

TOMATOES—Last year 355 acres of tomatoes produced over $800,000, establishing this as one of the Coachella Valley's more profitable crops . . .

During the war it served as a naval station for amphibious training.

The Coachella Valley is an arid region of mild, short winters, and long, extremely hot summers. It affords virtually a 12-month growing season. The valley has an annual rainfall of less than four inches and temperatures have ranged from 12° to 125°. The aridity of the valley can be explained by the high peninsular range on the west which precipitates moisture from the air moving in from the Pacific Ocean.

Only a bare half century ago the entire valley was barren desert where ocotillo, mesquite, greasewood, palo verde, cacti, sagebrush, and other arid plants grew unmolested. Today the developed area is a land of productive date and citrus groves, truck and field crops—of flourishing towns and prosperous farmers.

Migration into the valley started soon after the Southern Pacific Railroad built its main line through Indio in 1879. Indio is 130 miles southeast of Los Angeles and about 90 miles north of the Mexican border. Settlers in sizeable numbers were not attracted to the valley until 1894 when the presence of artesian water was discovered. From 1900 to 1903, 200 wells were drilled and by 1909 there were from 350 to 400 wells, about 300 of which were artesian.

The rapid expansion of agriculture which followed the establishment of these wells imposed a heavy drain on the underground water supply, and at present most of the wells require pumping. The water table has lowered progressively and now is from 50 to 90 feet below the ground surface. Continuing and increasingly rapid recession testifies to the inadequacy of the supply to meet present demands. Indications are that it is incapable of irrigating, over an extended period, more than 8,000 to 10,000 acres. And this condition is the compelling influence back of the building of the Coachella Canal to bring water to the valley—water which is needed so direly to supplement the underground storage and thus preserve the valley's prevailing economy and pave the way for its ultimate expansion.

Developed under desert conditions of extreme heat and little rainfall, the valley's topsoils are highly productive with irrigation despite their low content of organic matter.

Agriculture is the principal industry in the Coachella Valley but from it have sprung side industries like packing and transportation. The production, processing, and transportation of valley crops provides work for thousands of people both in the valley and in other areas of the Nation.

Agriculture, of course, is aided by the year-round growing season. While farm lands in the colder climates are virtually idle during the winter months, the valley ships large quantities of winter vegetables and tree fruits to all parts of the Nation where they find favored places on dinner tables. The specialty crops produced in the valley are not among the "surplus" commodities which caused such a problem in the prewar years.

AND GRAPEFRUIT—Seventeen percent of the desert grapefruit grown in California and Arizona comes from farms of the valley . . .

Last year the valley produced crops valued at almost $11,000,000. Largely because of abnormal rainfall during the 1945 ripening period, resulting in a reduced date yield, the crop valuation was about $3,000,000 less than in 1944. In 1937 the crop valuation was only about $2,000,000, while in 1940 it was $5,600,000. This sharp rise can be attributed largely to the increased prices for farm products during wartime.

The average crop value of the past two years has exceeded $700 per crop acre. Some of the principal crops produced in the valley include dates, citrus, grapes, alfalfa, sweet corn, onions, green beans, cantaloupes, carrots, and tomatoes. The valley accounts for about 90 percent of the date crop grown in this country and 17 percent of the total production of desert grapefruit grown in California and Arizona.

Currently about 50 percent of the valley's irrigated area is in tree fruits, 40 percent in truck crops, and 10 percent in field crops. From 1920 to 1945 the acreage of tree-fruit crops jumped from 900 acres to almost 7,000 acres, while the truck-crop acreage rose from 3,120 acres to over 6,000 acres for the same period. In 1945 there were 2,450 acres of both bearing and nonbearing grapefruit trees, 4,108 acres of dates, and about 3,500 acres of grapes.

The valley's high temperature, long growing season, low humidity, and freedom from rain during the ripening period create ideal conditions for the production of dates. Date production, with the importation of date species from the Near East, was greatly expanded in the valley following the establishment in 1904 of the Date Experiment Station at Indio. Eighty percent of the date acreage is of the choice Deglet Noor variety.

The sandy loam soils of the valley are ideally suited for the production of citrus fruit as well as truck crops. The quality of these crops is excellent and high prices make it profitable to ship them long distances. Truck crops especially have been a source of good income as growers are able to obtain higher prices for out-of-season production.

Cotton, a popular crop as recently as 1937, has declined in acreage and in 1945 no acreage was reported. In 1923 this crop was the most popular in the valley and occupied 4,500 acres, the largest acreage of any crop. The lands formerly devoted to cotton now are planted largely to flax, which is grown for the seed.

The success of the valley in the comparatively short period of development was not haphazard chance. It was achieved by the cooperation of hardy and ambitious farmers who early realized the necessity and advantages of working together.

In 1918, farmers in the Coachella Valley organized the present Coachella Valley County Water District. The district has as its primary objectives: (1) the protection of existing water rights; (2) improvement in the use of flood waters of the Whitewater River by building spreading dams; and (3) bringing supplemental water from the Colorado River to the valley.

(Continued on page 163)

AND DATES—The valley produces 90 percent of the domestic date crop. This modern home nestles in a date grove near Indio, Calif.

Culled From Official Files

THOUSANDS OF ACRES of irrigated land in Mexico, west of the Colorado River, are being benefited by emergency water releases from the All-American Canal via the Pilot Knob wasteway.

While the United States is not bound under treaty with Mexico to provide irrigation water via the All-American Canal until Davis Dam is completed and in operation, observance of "good neighbor" policy has prompted such deliveries during the last three years.

Lowering of the Colorado River bed below the border has made normal diversions via the Alamo Canal impossible. Although the Republic of Mexico is permitted by the treaty to build a temporary diversion dam to correct this condition pending completion of Davis Dam, thus far it has not undertaken construction.

☆ ☆ ☆

WELLS ARE BEING DRIVEN on two predevelopment farms on the Columbia Basin project, one near Pasco and the other in the Moses Lake vicinity. The farms will be operated jointly by the Bureau of Reclamation, the Bureau of Plant Industry of the Department of Agriculture, and Washington State College Experiment Station. They will demonstrate farming and irrigation practices for the thousands of families who will establish homes in the Columbia Basin project when the permanent irrigation system is completed.

The two farms will be partially under cultivation by this fall. A wide variety of crops will be tested, as well as soil permeability.

☆ ☆ ☆

COMMENTING ON S. 1688, a bill to reauthorize the Gila project, Arizona, and to extend the repayment period for more than 40 years, the Bureau of the Budget recommended amendment to require "payment of interest in addition to construction cost for any period in excess of 40 years, plus the 10-year development period over which construction repayments are spread."

☆ ☆ ☆

COMMISSIONER OF RECLAMATION Michael W. Straus recently visited Reclamation projects in Texas, New Mexico, Oklahoma, and Colorado.

During June Commissioner Straus accompanied Secretary of the Interior J. A. Krug on a northwestern tour that included Reclamation meetings in Laramie, Wyo.; Butte, Mont.; Denver, Colo.; Salt Lake City, Utah; Boise, Idaho; Grand Coulee Dam, Ephrata; and Spokane, Wash.

☆ ☆ ☆

Construction programmed by the Bureau for 1947 and for the succeeding 4 years on 82 authorized irrigation and multiple-purpose projects will give on-site and indirect employment to approximately 440,-400 persons, a total of 300,600 man-years.

☆ ☆ ☆

THE COLUMBIA BASIN Inter-Agency Committee held its first meeting at Portland, Oreg., without representation from the State of Washington. Governor Mon C. Wallgren declared that the representation planned for Washington was inadequate. Chairmanship of the committee is to rotate through the Departments of Interior, War, and Agriculture, the Federal Power Commission, and the basin States. Col. Theron D. Weaver, Corps of Engineers, is chairman for 1946.

Our Back Cover

Over Boulder Dam's 45-foot-wide roadway bridging the Colorado more houses for workmen who will further bend the river to the service of man. Barracks from the former Army Camp Williston, Boulder City, Nev., will house contractors' employees at Davis Dam site near Kingman, Ariz. Ten barracks, sawed into four sections each, were moved over the dam during the 115-mile trip.

PRESENTATION of the Central Valley Basin Report to the President and to Congress came nearer with receipt of comments from the Governor of California. President Truman recently directed the Bureau of the Budget temporarily to impound the funds provided in the War Department civil functions appropriation for construction of Kings River project, pending submission of the Central Valley comprehensive basin plan to the Congress.

☆ ☆ ☆

THE SANTA BARBARA County comprehensive basin plan, California, has been submitted to the President for transmission to the Congress.

Paonia, Colo., Project Report has been submitted to the State of Colorado, to the Secretary of War, and to the members of the Federal Inter-Agency River Basin Committee.

☆ ☆ ☆

AVERAGE FARM real estate values in the Pacific Coast States have gone 24 points beyond the 1929 inflationary peak index, according to the Bureau of Agricultural Economics report for the year ended March 1. Farm lands in Colorado, Wyoming, and Montana have gone up more than 102 percent since 1939. Other States and percentage increases above the 1936–1939 average follow: Washington, 88; Oregon, 79; Idaho, 82; Utah, 45; Nevada, 47; California, 82; Arizona, 68; New Mexico, 86; Oklahoma, 71; Kansas, 58; Nebraska, 37; South Dakota, 31; North Dakota, 29.

☆ ☆ ☆

AN ANCIENT, possibly pre-Inca, irrigation system and aqueduct have been disclosed by aerial photographs of the Viru River Valley of Peru. The Smithsonian Institute, now conducting an expedition to investigate the valley for evidences of early civilization, has requested loan of an irrigation expert from the Bureau of Reclamation to aid in the study.

☆ ☆ ☆

THE SECRETARY OF THE NAVY has authorized lease of a 10,000-kilowatt railway-mounted mobile generator to be used to relieve power shortages in central and western Arizona. By fall, carryover storage in Salt River reservoirs near Phoenix will be exhausted and power production will have fallen from 100 to 300 million kilowatt-hours short of requirements.

Reservoirs as National Wildlife Refuges

by WARREN S. BOURN*

Reservoirs may or may not contribute greatly towards the conservation and the further restoration of the Nation's natural resources in fish and wildlife. That they do so to a degree commensurate with present and future national and continental requirements is the ultimate goal of the National Wildlife Refuge Program.

AT HOME IN THE WEST—*This Canada Goose family lives in the marshes of the Bowdom National Wildlife Refuge, Montana. Reclamation reservoirs are important in wildlife conservation and propagation plans.*

Refuges Established

How reservoirs serve this purpose varies with their capacity to provide fish and wildlife with essential habitat for life and reproduction, or in other words, to supply favorable conditions for sustenance, breeding, and protection. The adaptation of reservoirs to satisfy any or all of such vital requisites is mainly contingent on their primary purpose of creation; their physical and chemical attributes; their location in relation to possible and convenient utilization by fish and wildlife, as well as by an appreciable population of mankind; their methods of operation and management; their available water supply; and their capability for additional development and management as wildlife refuge.

According to the primary purpose of construction, artificial impoundments of water may be classed as hydroelectric, flood control or storage, irrigation, navigation, municipal water supply, and fish and wildlife pools or reservoirs. With the exception of municipal water supply reservoirs, and omitting those constructed specifically for the purpose of fish and wildlife conservation, the U. S. Fish and Wildlife Service has established in cooperation with other agencies national wildlife refuges on all these types where fish and wildlife usually are assigned secondary to minor rights. Factors associated with the primary purpose of the reservoir and its operation usually determine the value of the impoundment as a fish and wildlife refuge.

Power Reservoirs Important

Naturally, those water impoundments created specifically for the purpose best serve the interests of fish and wildlife conservation. Where possible, these have been located in the breeding and wintering range and within the major flight lanes of migratory waterfowl, where conditions are favorable for supporting the growth of natural stocks of plant and animal foods. Their construction has been such as to afford complete water control so as to furnish a stable level during critical periods of spawning and breeding and to provide for the maximum production of food derived from the proper balancing of desirable submergent and emergent vegetation. The latter in turn is regulated by appropriate control and manipulation of water levels, for the growth of the various types of aquatic and semiaquatic vegetation, with which this Service is concerned, is dependent mainly on specific water and soil relations.

Next in importance, from the standpoint of fish and wildlife conservation, are the hydroelectric reservoirs, where suitably located and where the water quality is satisfactory. Ordinarily, the method of their operation presupposes a rapid discharge of excess flood waters and a relatively slight range in depth of water between maximum and minimum operating levels. The body of dead storage water is usually of sufficient expanse on major projects to serve as a suitable conservation pool, in which the vital requirements of fish and wildlife are met.

Seldom do reservoirs constructed or operated for other or multiple purposes afford such favorable conditions. Usually, in such reservoirs, the fluctuations and drawdowns are of sufficient magnitude to preclude the spawning of game fish and the growth of essential vegetative food for wildlife, particularly waterfowl. Most of these impoundments have no semblance of a conservation pool and in some the water use is so heavy that at critical times for wildlife the reservoirs are dry. Some may provide for a certain amount of storage that merely serves as silting space and can by no means be considered as a conservation pool for fish and wildlife, because in this connection silt-laden water is as detrimental as drastic fluctuations or drawdowns and has the same deleterious effects.

Adequate Water Necessary

In some instances, however, pools created for the primary purpose of storing water to be used in irrigation serve that of fish and wildlife conservation, particularly where there is a water supply sufficiently surplus to irrigation needs for the maintenance of an adequate conservation pool, or where this, or its equivalent in subimpoundments, is produced through proper modifications in design or method of operation. On such reservoirs, where located strategically in relation to migratory waterfowl use, the U. S. Fish and Wildlife Service in cooperation with the U. S. Bureau of Reclamation has established national wildlife refuges that are considered very important in the Service's conservation program.

*Biologist, Division of Wildlife Refuges, U. S. Fish and Wildlife Service.

National wildlife refuges established on Reclamation reservoirs and projects include Havasu Lake and Imperial (partly in California) in Arizona; Clear Lake, Lower Klamath (partly in Oregon), Salton Sea, and Tule Lake in California; Deer Flat and Lake Walcott in Idaho; Bowdoin, Pishkun, and Willow Creek in Montana; North Platte in Nebraska; Fallon in Nevada; Carlsbad and Rio Grande in New Mexico; Cold Spring, McKay Creek, and Upper Klamath in Oregon; Belle Fourche in South Dakota; Strawberry Valley in Utah; Conconully Lake in Washington; and Pathfinder in Wyoming.

More Refuges Needed

Considering the wide gaps in the national wildlife refuge system throughout the western part of the United States where water and its use are at a premium, there are too few refuges in the major flyways of migratory waterfowl. In those sections where all water rights have been appropriated for irrigation purposes, necessary links in refuge chains within the migratory waterfowl flight lanes to meet increasing public demands can be added only through the establishment of national wildlife management areas on Bureau of Reclamation projects. There is no other recourse open to the American public. Before such refuges are established, however, it may be necessary to effect essential modifications in design and methods of operation as well as adjudication of water rights and distribution so that at least the minimum requirements of fish and wildlife will be satisfied. Any extra cost entailed for this is considered justifiable where the utilization of a public natural resource such as water is involved. In most cases, a conservation pool and not a silt pool will be required to be maintained throughout critical periods for fish and wildlife and during the season of vegetative growth. In other instances, little or no change in reservoir design or method of operation will be necessary.

In the establishment, development, and operation of national wildlife refuges on reservoir areas for improving fishing and hunting, the Fish and Wildlife Service follows rather fixed practices. On those areas assigned for the purpose, fish and wildlife habitat is intensively developed to obtain the highest possible production. Along reservoir shorelines some type of vegetation ordinarily will develop naturally. More often this type will be obnoxious varieties, from the standpoint of wildlife and recreational use. Types of such nature include salt cedar, willow, cocklebur, lotus, and many others.

Public Hunting Provided

It is the Service's policy to plant along the shores desirable forms, such as bulrushes and spikerushes, before obnoxious forms may become established, and to stock the water where the growth of aquatics is possible with choice pondweeds before the area can be taken over by objectionable forms such as lotus, coontail, and others. Once obnoxious species become established, efforts are made by appropriate means to eradicate or to control the growths, and as rapidly as possible to replace them with desirable forms that better serve the purpose of recreation and fish and wildlife conservation.

Where the reservoir area assigned as a wildlife management unit is large enough, for example, on the Bowdoin and Deer Flat Reservoirs, it is divided into refuge and public hunting sections. The latter are operated cooperatively with State Game and Fish Commissions and prove quite satisfactory in wildlife management for the removal of surplus stock. All national wildlife refuges are open to public fishing done in accordance with State laws and regulations, except in specific areas at times when wildlife would be unduly disturbed during critical periods and the purpose of the refuge defeated by fishing activities. The water areas, where feasible, are kept well stocked with appropriate species of fish, and no fee other than a State license is charged for fishing on a national wildlife refuge. Funds received for economic uses, such as grazing, are turned over to the Reclamation Bureau authorities for use towards liqui tion of construction and operation costs the irrigation project.

The value of irrigation reservoirs as wi life refuge areas is shown by many favora records in the files of the Fish and Wildl Service. The realization of the ultim plans for the National Wildlife Refu System to acquire and maintain adequ habitat for the proper perpetuation a preservation of the Nation's wildlife sources depends to a great extent on ext sions in the national wildlife refuge cha to include irrigation reservoirs in strate areas where creation of refuges otherw would be impossible. Only in this way n fishing and hunting conditions be impro to keep pace with public demand and pectation for sport, recreation, and welfa

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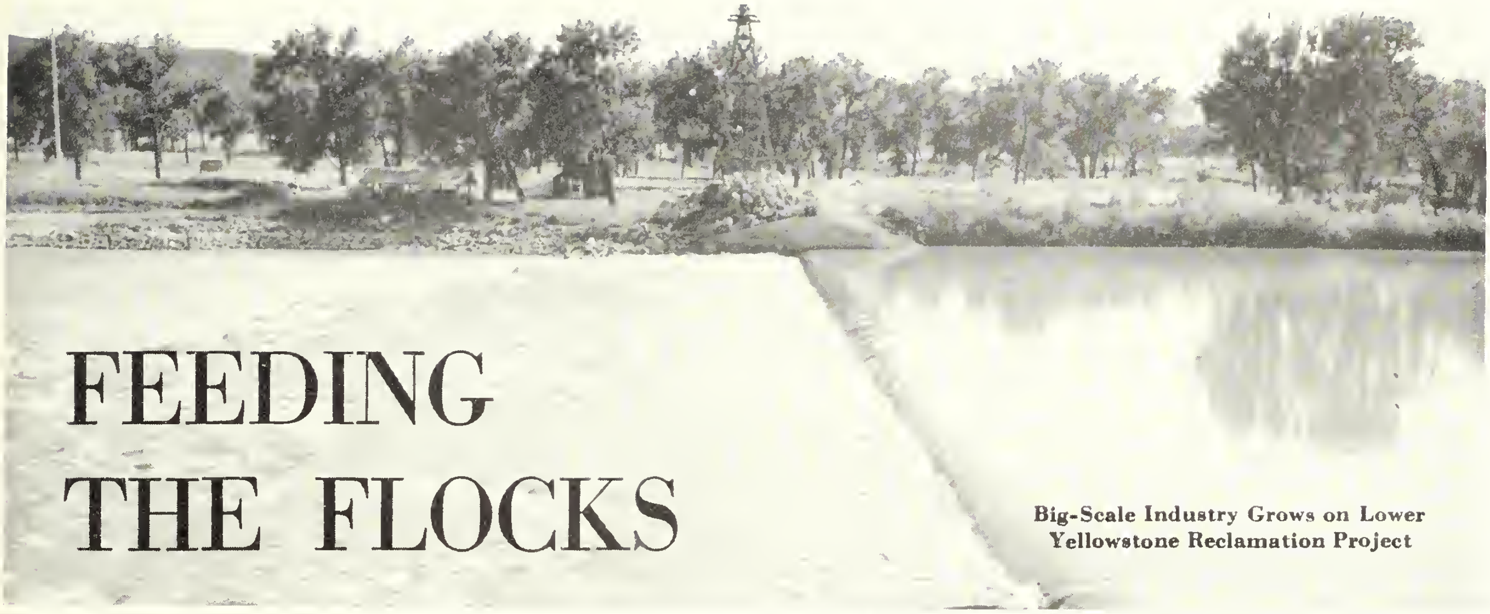
Less than one-third of 1 percent to pay on the amount due is the rec of the Boise, Idaho, project. Assist Commissioner William E. Warne of Bureau of Reclamation's Washington of praised the project record during a visit the Boise regional office. He stated t Congress is making a close check of repayment records of Reclamation proj on which water users, under the law, m return the cost of the investment to the F eral Treasury.

MODELS TRANSMOUNTAIN PROJECT—*Julius P. Ambrusch, of the Denver laboratories of Reclamation, puts finishing touches on a section of a topographic relief model of the Colorado-Big Thompson project. Now under construction, the project will provide a supplemental water supply by transmountain diversion for approximately 615,000 acres of land and will generate power. One of the chief engineering features is the 13-mile-long Alva B. Adams Tunnel, which will carry water through the Continental Divide. By comparison, the first major irrigation development in northern Colorado was construction of the Big Thompson ditch by private interests in 1864 to water 1,500 acres of land.*



FEEDING THE FLOCKS

Big-Scale Industry Grows on Lower Yellowstone Reclamation Project

Grains, Alfalfa, and Sugar Beet Byproducts Provide Home-grown Feed for Stock

Utilization of grains, alfalfa hay, and sugar beet byproducts through stock feeding operations has become a big scale industry on the Lower Yellowstone Reclamation project.

It is an industry that has gained Statewide attention in both Montana and North Dakota. Each year the project is the focal point for farmers, stockmen, and other businessmen attending the annual feeders' day "tour" to study feeding methods employed by experienced operators. More than 200 attended the feeders' tour held early in January and more than 450 enjoyed the "wind-up" banquet. The tours are sponsored by the Montana Extension Service and the civic organization at Sidney, Mont., project headquarters.

Feeding operations on the Lower Yellowstone project began on a small scale more than 25 years ago. While present records are not exact, it is estimated that approximately 2,000 lambs were on feed that year. By 1930 operations had increased to 20,000 lambs and 1,000 cattle, and 10 years later 183,000 lambs and 3,200 cattle were being fattened in Lower Yellowstone feed yards.

The peak year was 1943, with a total of 190,000 lambs and 4,000 cattle. During the current season 134,000 lambs and 6,500 head of cattle were fed out.

The reduction in the number of feeder lambs was due to unstable market conditions at the time operators completed their purchases last fall. If feeder lambs had been available later, it is believed that more than 175,000 lambs would have been in the lots during the feeding season. Shortage of labor also had its effect on feeding operations.

It is estimated that more than 75 percent of the feeding operation carried out on the Lower Yellowstone project is by men who utilize the feed grown on their respective farms. Others buy their feeds from dry land operators nearby or purchase surplus feed and hay grown on the project.

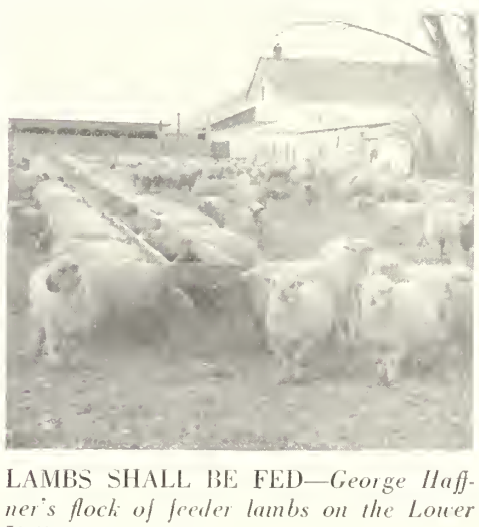
During early fall the lambs are fed hay in the feed lots. During the day, or part of the day, the flocks are permitted to forage on beet tops in the field. Early in November the lambs are placed in the lots and fed a small amount of grain, corn silage, or beet pulp, all the hay they can consume, and in most instances a small amount of mineral and linseed meal. The grain is increased from time to time. Beet pulp rations also are increased, with a decrease in the amount of hay and other roughage. The approximate gain in 120 days is 30 pounds per lamb.

The common practice in feeder cattle operations is to purchase the stock early in October. Feeder cattle are turned into a corn field, either on dry land or irrigated land. About November 15, the cattle are placed in feeding pens and receive rations of hay, grain, beet pulp, mineral, and possibly linseed meal. The average feeding period is 200 days, with an anticipated gain of 2 to 2¼ pounds per day.

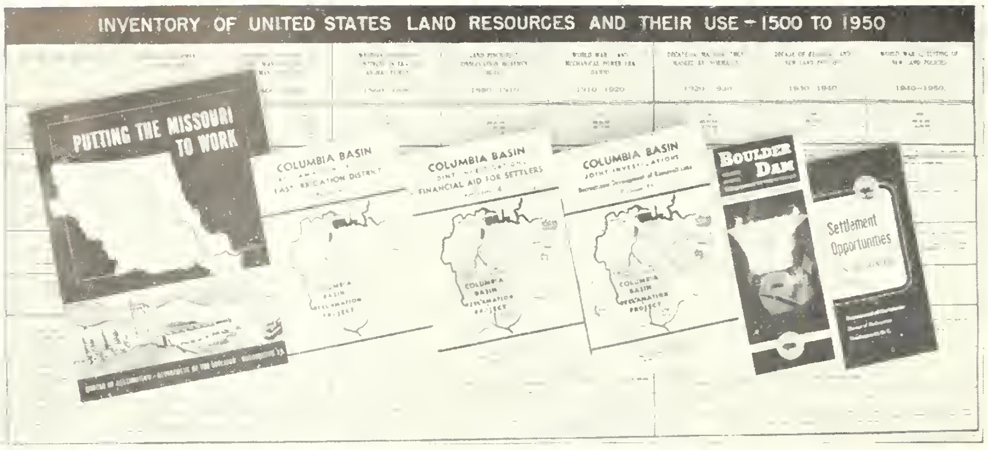
Feeding operations on the Lower Yellowstone project received their first indirect impetus with the establishment of a sugar beet factory at Sidney, Mont., in 1925. This provided a ready market for a cash crop, adaptable to that area, and in a short time growers found that sugar beet byproducts made excellent livestock feed. Thus the feeding industry grew proportionately with increased sugar beet production and in 1945, 16,455 acres—out of 48,091 acres actually irrigated on the project—were in sugar beets. This crop had a gross value of $1,482,465 or a gross per acre return of $90.15. Growers utilized tops from 118,000 tons of beets in livestock feeding.

WATER MUST BE AVAILABLE—*The diversion dam at Intake, Mont., provides the irrigation water for the Lower Yellowstone project.*

CATTLE MUST EAT—*Part of the 74 head of Hereford steers fed out by Henius Hanson on the Lower Yellowstone project during the 1945–46 season.*



LAMBS SHALL BE FED—*George Haffner's flock of feeder lambs on the Lower Yellowstone project.*



RECLAMATION'S BOOKSHELF

Recent Bureau Publications

1. *Inventory of United States Land Resources and Their Use—1500 to 1950.*—A chart for wall display and study. To be obtainable soon from the Superintendent of Documents, Washington, D. C.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest reports released are:

Problem 14, *Financial Aid for Settlers*—25 cents.

Problem 26, *Recreational Development of Roosevelt Lake*—75 cents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the East Columbia Basin Irrigation District—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy from the Superintendent of Documents, Washington, D. C.

4. *Maps of Seven States Showing Water Resources Development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C.

5. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy from the Superintendent of Documents, Washington, D. C.

6. *Approved Missouri River Plan Map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

7. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to your Regional Director.

8. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ending June 30, 1945). Obtainable on request to the Bureau of Reclamation as directed above.

9. *Boulder Dam.*—Illustrated folder on the world's highest dam. Obtainable on request to the Bureau of Reclamation at Washington or Boulder City, Nev.

Miscellaneous Publications

"Golden River—What's to be Done About the Missouri?" by Joseph Kinsey Howard, in *Harpers Magazine*, May 1945, page 511. A study of the Missouri basin problems by a newspaperman and author of *Montana*.

"Aqueduct for Salt Lake City," by L. R. Dunkley, construction engineer, Provo River (Utah) project, Bureau of Reclamation, in *Civil Engineering*, April 1946, page 160. Illustrated. More than half the population of the State of Utah will be directly helped by the Provo River project. One of its most important features is the Salt Lake Aqueduct, which will convey a needed increase in the water supply of Salt Lake City, as well as supplemental water for irrigation and for contiguous communities.

"China to Build Biggest Dam," in *Compressed Air Magazine*, April 1946, page 107. Illustrated. The Chinese Government—aided by engineers of the Bureau of Reclamation—is planning the largest irrigation and hydroelectric power development the world has ever known. A 750-foot dam—24 feet higher than Boulder Dam—is to be built in the Yangtze Gorge as the key feature of the development.

"New Life for Old Land," by Robert West Howard, in *Steelways*, April 1946, page 24. Illustrated. The story of what fertilizer has meant to the American farmer. *Steelways* is published quarterly by the American Iron and Steel Institute, New York, N. Y.)

Letters to the Editor

The following appeared in the editorial columns of the Des Moines Register and Tribune:

WE HAD SOME HELP, ALL RIGHT

"The men who made this great State of Iowa, starting from scratch, did it with a minimum of interference and no help from Washington, and history does tell us that we turned out a mighty fine job, some mighty fine men, and some mighty wealthy men. All without Government help."—Lenox (Iowa) Time Table.

The stories and legends of individual pioneer hardships sometimes lead us to imagine that the early settlers of the great American West were entirely on their own, with no communication whatever with civilization and government.

That is a romantic picture, but it isn't so.

To make our Western States possible, the Federal Government maintained Army posts far and wide to clear the new territories and protect homesteaders. During the Indian wars we had an army of 25,000 soldiers in the field for years.

The Federal Government virtually gave away the original land to the men who came and occupied it, either free or at trivial cost.

The Government built the Cumberland Pike all the way from Maryland to Vandalia, Ill., and then turned the highway over to the States through which it ran.

The Federal Government established post offices and mail service.

The Government gave railroads 100 million acres in land grants so that they would come west and serve the newly forming States.

The Government maintained a protective tariff that would safeguard infant industries and agriculture, thereby permitting the new States to develop and prosper.

The Federal Government made land grants to the States for universities and agricultural colleges, so that they could advance culturally and scientifically.

And so on.

"And without Government help"? Hardly.

The pioneers earned the veneration that we accord them as a group—no doubt of it. But they had plenty of "help from Washington," too, or we should not have progressed anything like as rapidly as we did.

THEY ALSO SERVED

This letter appeared in The Times-Herald, Washington, D. C., May 27, 1946:

Planning and construction is not the greatest problem of the Bureau of Reclamation. The real task will be to maintain that high standard of integrity and efficiency established by the engineers and construction men of the Reclamation Service during a near half century of effort.

Although often the target of criticism by jealous politicians, the records of these engineers have been free from scandals of graft and misconduct. When fame has come they have accepted it in the same quiet manner in which they have constructed the great dams, irrigating systems and power houses.

Living, they are "Jack," "Bob," "The Chief," or the "Old Man" to those with whom they labor. Dead, they are lovingly and respectfully remembered. Their faults are forgotten.

The material monuments of their endeavors give effective testimony to their ability and patience. May the men and women of the Bureau of Reclamation continue to add only good to the great record already made.

ALLEN TRAVIS.

Notes to Contractors

Construction and Supplies for Which Invitations for Bids Will Be Requested During July

Project, division and State	Description of work or material	Estimated date invitation to be requested	Estimated bid opening date
Boulder Canyon—Nev	Distribution transformers, Boulder city.	July 1	Aug. 8
Columbia Basin—Wash	Embedded material, Grand Coulee pumping plant.	do	Do.
Do	Motor switchgear, Pasco relift pumping plants.	do	Do.
Do	Substation equipment, Pasco relift pump plants.	do	Do.
Davis Dam—Ariz	Main control board extension	do	Do.
Klamath—Tule Lake—Calif. Oreg.	Motor switchgear for pumping plant "D."	do	Do.
Missouri Basin—Kortes unit—Wyo.	3-13,333 kilovolt-amperes transformers.	do	Do.
Yakima—Roza—Wash	Lumber for wasteway No. 5	do	Do.
Do	Reinforcement bars for wasteway No. 5.	do	Do.
Central Valley—Delta—Calif	Valves for Clayton and Ygnacio pump plants.	July 3	Aug. 10
Central Valley—Kennett—Calif.	Construction of aerial tramway	July 7	Aug. 14
Altus—Okla	Structures for "C" drain	July 8	Aug. 15
Central Valley—Friant—Calif	Lumber for Friant-Kern Canal, station 1144 to station 1592.	do	Do.
Owyhee—Mitchell Butte—Oreg.	Reinforcement bars for Fletcher Gulch wasteway.	do	Do.
Do	Lumber for Fletcher Gulch wasteway.	do	Do.
Tucumcari—N. Mex	Earthwork and structures, Conchas Canal, station 3662+00 to 4152+46.3 and Lateral Unit No. 6.	do	Do.
Yakima—Roza—Wash	Earthwork, pipe lines, concrete lining, structures, lateral system, pump area 15.	do	Do.
Missouri Basin—Boysen unit—Wyo.	Construction of Boysen Dam (earth-fill) and power plant, and relocation of portion of C B & Q RR.	July 9	Aug. 16
Boise—Idaho	Hollow metal doors for Anderson Ranch powerhouse.	July 10	Aug. 17
Boulder Canyon—Nev	Valves and piping for jet pump installation.	do	Do.
Central Valley—Delta—Calif	Reinforcement bars, Contra Costa Canal, station 2321 to end.	do	Do.
Do	Lumber and piling, Contra Costa Canal, station 2321 to end.	do	Do.
Do	Wrought-iron plates, Contra Costa Canal, station 2321 to end.	do	Do.
Colorado-Big Thompson—Colo.	Conductor for Granby-Estes Park transmission line.	do	Do.
Do	Steel towers, Granby-Estes Park transmission line.	do	Do.
Missouri Basin—Lower Marias unit—Mont.	Construction of Tiber Dam (earth-fill).	do	Do.
Colorado-Big Thompson—Colo.	Poles and crossarms, Granby-Estes Park transmission line.	July 12	Aug. 19
Yakima—Roza—Wash	Vacuum pumps, Yakima-Roza pumping plants.	do	Do.
Do	Valves, Yakima-Roza pumping plants	do	Do.
Altus—Okla	Earthwork and structures, Ozark Canal, station 0+00 to 778+22.	July 15	Aug. 22
Boise—Idaho	30-ton crane, outlet works, Anderson Ranch Dam.	do	Do.
Colorado-Big Thompson—Colo.	Insulators for Granby-Estes Park transmission line.	do	Do.
Do	Hardware for Granby-Estes Park transmission line.	do	Do.
Columbia Basin—Wash	Ventilating equipment for right power plant, Grand Coulee.	do	Do.
Columbia Basin—Wash	2,000-pound freight elevator, block 64, Grand Coulee Dam.	July 15	Aug. 22
Hungry Horse—Mont	Clearing part of Hungry Horse Reservoir.	do	Do.
Missouri Basin—Canyon Ferry unit—Mont.	Construction of Canyon Ferry Dam and power plant.	do	Do.
Rio Grande—N. Mex	Control facilities, Elephant Butte—Socorro transmission line.	do	Do.
Yakima—Roza—Wash	Pumping plant discharge lines, pump areas 1 to 17.	do	Do.
Gila—Yuma-Mesa—Ariz	Earthwork, lining, and structures, "A" canal and "A" and "B" laterals, unit No. 1.	July 17	Aug. 24
Missouri Basin—Wogansport unit—N. Dak.	Pumping plant, earthwork, and structures, canals and laterals.	do	Do.
Central Valley—Delta—Calif	Reinforcement bars, Delta-Mendota canal, station 686 to 1365.	July 18	Aug. 25
Colorado-Big Thompson—Colo.	Pump discharge valve control mechanism, Granby pumping plant.	July 19	Aug. 26
Missouri Basin—Missouri River pumping unit—N. Dak.	Motor switch gear and substation equipment for Square Butte and Wogansport pumping units.	do	Do.
Missouri Basin—Savage unit—Mont.	Motors and control for Savage pumping plant.	do	Do.
Central Valley—Kennett—Calif.	Power cable for Keswick power plant.	July 20	Aug. 27
Colorado-Big Thompson—Colo.	Conduit and fittings for control, and station service equipment at Granby Dam.	do	Do.
Columbia Basin—Wash	Materials and labor, transmission lines, Pasco pumping plant.	do	Do.
Do	Ground cable, connectors, etc., for Grand Coulee pumping plant.	do	Do.
Davis Dam—Ariz	Terminal facilities and steel structures, Phoenix-Tucson line.	do	Do.
Do	Terminal facilities: 20,000 kilovolt-ampere condenser, steel structures.	do	Do.
Missouri Basin—Savage unit—Mont.	Construction of pumping plant and appurtenant structures.	do	Do.
Parker Dam Power—Calif	Materials for machine shop building, Parker power plant.	do	Do.
Do	Rebuild Gila substation, changing from timber to steel.	do	Do.
Yakima—Roza—Wash	Construction of pumping plant and appurtenant structures.	do	Do.
Minidoka—Gooding—Idaho	Earthwork and structures, lateral system.	July 22	Aug. 29
Central Valley—Kennett—Calif.	Conductor, poles, and crossarms for Shasta-Keswick transmission line.	July 25	Sept. 1
Missouri Basin—Square Butte unit—N. Dak.	Construction of pumping plant and appurtenant structures.	do	Do.
Riverton—Wyo	Earth work and structures, Wyoming canal, station 883 to 1600, and laterals W 17.96 to W-29.84, and sublaterals.	do	Do.
Boise—Payette—Idaho	Piping for "C" line canal pumping plant.	July 26	Sept. 2
Columbia Basin—Wash	Motor operated valves for Pasco pumping plant.	do	Do.
Klamath—Tule Lake—Calif.-Oreg.	Earthwork and structures, laterals and drains, Coppeck Bay area extension, Modoc unit.	July 29	Sept. 5
Boise—Payette—Idaho	12- by 13.38-ft. fixed wheel gate and frame, Cascade Dam.	July 30	Sept. 6
Boulder Canyon—Nev	Construction of Boulder City High School.	do	Do.
Davis Dam—Calif.-Ariz	522 feet steel penstocks.	do	Do.

(Continued on next page)

Construction and Supplies for Which Invitations for Bids Will Be Requested During July—Continued

Project, division and State	Description of work or material	Estimated date invitation to be requested	Estimated bid opening date
Missouri Basin—Owl Creek unit—Wyo.	36-inch hollow jet valve for Anchor Dam.	July 30	Sept. 3
Palisades—Idaho	Housing, miscellaneous buildings, and utilities for Government camp.	July 30	do.
Boulder Canyon—Nev.	Surge suppressors, valves and manifolds for Boulder City supplemental water supply.	July 31	Sept. 7
Columbia Basin—Wash.	Lighting equipment and fixtures, left power plant, Grand Coulee.	July 31	Sept. 7
Boulder Canyon—Nev.	Motor control equipment for pumping plants 1 and 2, Boulder City supplementary water supply.	July —	Sept. —
Missouri Basin—Owl Creek unit—Wyo.	Motor switchgear and power substation equipment for Lucerne pumping and relift pumping plants.	July —	Sept. —

Construction and Supply Contracts Awarded During May

Specification No.	Project, division, and State	Date contract awarded	Description of work or material	Contractor's name and address	Contract amount
1182	Altus—Okla	May 1	Earthwork and structures, west canal laterals W-6.2 to W-11.5, and sublaterals; Blair laterals and sublaterals.	James and Phelps Construction Co., Oklahoma City, Okla.	$299, 547. 00
1202	Missouri Basin—Kortes unit—Wyo	do	Schedule 2—Circuit breakers and spare parts	Westinghouse Electric Corp., Denver, Colo	1, 760. 00
		do	Schedule 3—Disconnecting switches and spare parts.	A. B. Chance Co., Bowie Switch division, San Francisco, Calif.	1, 080. 75
1199	Missouri Basin—Boysen unit—Wyo	May 23	Schedule 1—Circuit breakers and spare parts	Allis-Chalmers Manufacturing Co., Milwaukee, Wis.	2, 579. 00
		May 2	Schedule 2—Disconnecting switches and spare parts.	A. B. Chance Co., Bowie Switch division, San Francisco, Calif.	1, 968. 38
		May 13	Schedule 3—Lightning arresters	General Electric Co., Denver, Colo	362. 88
		May 8	Schedule 4—Current transformers	Westinghouse Electric Corp., Denver, Colo	242. 58
		May 2	Schedule 5—Indicating demand meters	do	181. 26
R 6-1	Missouri Basin—region VI	May 6	Aerial photographs for reservoir sites and other areas of Missouri Basin.	Fairchild Aerial Surveys, Inc., Los Angeles, Calif	199, 840. 00
1197	Parker Dam Power—Calif	do	69,000-volt, 1,000,000-kilovolt-ampere oil circuit breaker.	Pacific Electric Manufacturing Co., San Francisco, Calif.	8, 305. 00
1205	Davis Dam—Ariz.—Nev	May 7	Item 1—Anchor bolts for gate frames	Rockwell Engineering Co., Chicago, Ill	2, 080. 00
1165	Central Valley—Kennett—Calif	May 8	2 hydraulic gate hoists, accessory equipment and parts.	Pacific Coast Engineering Co., Alameda, Calif	81, 250. 00
1251	Boise—Idaho	May 9	Clearing part of Cascade reservoir site	Wixson & Crowe, Redding, Calif	191, 000. 00
1245	All-American Canal System, Calif	May 10	Item 1—7 radial gates for Coachella canal	Pacific Coast Engineering Co., Alameda, Calif	5, 490. 00
		do	Item 2—7 hoists, Coachella canal	Monarch Forge and Machine Works, Portland, Oreg.	8, 960. 00
1212	Columbia Basin—Wash	do	Schedule 2—Disconnecting switches and spare parts.	Delta Star Electric Co., Chicago, Ill	6, 851. 60
1235	do	do	2 350-ton traveling cranes	The Morgan Engineering Co., Alliance, Ohio	252, 750. 00
1255	do	do	3 oil-storage tanks	Lincoln Steel Works, Lincoln, Nebr	2, 700. 00
1222	Boise—Payette—Idaho	May 13	Schedule 2—Disconnecting switches and spare parts.	Graybar Electric Co., Denver, Colo	1, 367. 60
1168	Boulder Canyon—Nev	do	Annunciator relays and cabinets	Westinghouse Electric Corp., Denver, Colo	1, 772. 00
1241	Yakima—Roza—Wash	do	Steel pipe for siphons "A" and "B"	Berkeley Steel Construction Co., Berkeley, Calif	5, 770. 00
1238	Hungry Horse—Mont	May 14	Construction of 25 duplex cottages	Montana Engineering and Construction Co., Helena, Mont.	225, 000. 00
1270	Colorado-Big Thompson—Colo	do	Schedules 2 and 3—Voltage regulators, circuit breakers, spare parts.	Westinghouse Electric Corp., Denver, Colo	10, 929. 00
1219	Columbia Basin—Wash	do	2 centrifugal pumps, Pasco pumping plant	Worthington Pump & Machinery Corp., Harrison, N. J.	19, 800. 00
1223	Central Valley—Kennett—Calif	May 17	3 15 by 19.05 ft. penstock intake coaster gates for Shasta Dam.	American Bridge Co., Denver, Colo	159, 556. 00
1258	do	May 20	Trashrake and hoist for penstock intake trashracks, Keswick Dam.	Pacific Coast Engineering Co., Alameda, Calif	8, 210. 00
1298	Boise—Idaho	May 21	Steel warehouse, Anderson Ranch Dam	American Bridge Co., Denver, Colo	13, 221. 00
1228	Parker Dam Power—Calif	May 22	Aluminum railing and curbs	Newman Bros., Inc., Cincinnati, Ohio	8, 971. 00
1217	Shoshone and Kendrick—Wyo	do	Coupling capacitators and carrier line traps	General Electric Co., Denver, Colo	2, 455. 25
1270	Colorado—Big Thompson—Colo	May 21	Schedules 1 and 4—Transformers and spare parts for Estes construction substation.	do	3, 420. 48
1274	All-American Canal System, Calif	May 23	Street surfacing, sidewalks, curbs, gutters, and drainage system for Coachella Government camp; highway surfacing and oil-mix ditches, Mecca-Blythe road relocation.	Eggleston and Root, San Bernardino, Calif	29, 999. 25
1237	Klamath—Tule Lake—Oreg.—Calif	do	Earthwork and structures, canals and drains, "N" canal system, Modoc unit.	George R. Stacy, Klamath Falls, Oreg	112, 781. 00
F-38, 491-A-1	Columbia Basin—Wash	May 24	Modified portland cement for South Dam feeder canal pumping plant.	Superior Portland Cement Co., Seattle, Wash	360, 750. 00
				Lehigh Portland Cement Co., Chicago, Ill	362, 000. 00
1128	do	May 28	6 vertical-shaft centrifugal pumps	Pelton Water Wheel Co. and Byron Jackson Co., San Francisco, Calif.	1, 049, 325. 00
1272	Boise—Idaho	May 29	60-ton traveling crane, 10-ton auxiliary hoist	Judson Pacific Murphy Co., San Francisco, Calif	35, 444. 00
1227	Central Valley—Friant—Calif	do	2-30-ton gantry cranes	Cyclops Iron Works, San Francisco, Calif	75, 360. 00
1203	Davis Dam—Ariz.—Nev	do	Item 1—5 17.5 by 31.66 feet fixed wheel gates	American Bridge Co., Denver, Colo	169, 305. 00
		do	Item 2—5 hydraulic hoists	McKiernan-Terry Corp., Harrison, N. J	131, 530. 00
1178	Central Valley—Friant—Calif	do	Friant-Kern Canal stilling basin, Cottonwood Creek Bridge, landscape area improvements.	Fred J. Maurer and Son, Eureka, Calif	265, 515. 00
1265	Colorado-Big Thomspon—Colo	do	Granby Dam and dikes	Granby Constructors, Denver, Colo	5, 988, 969. 00
1200	Missouri Basin—Baysen unit—Wyo	do	Transmission lines and distribution system for Boysen unit.	S. H. Reither, Aitkin, Minn	29, 536. 00
1195	All-American Canal System—Calif	May 31	Earthwork, canal lining, and structures, station 5725+00 to 6106+06, Coachella Canal.	Shea Co. and Morrison-Knudsen Co., Los Angeles, Calif.	990, 225. 50
	Region III				
GF-410	Gila—Yuma-Mesa—Ariz	May 8	Furnish equipment and level land	Hansard and Evins, Blythe, Calif	5, 000. 00
GF-411	do		do	do	9, 500. 00
GF-500	do	May 24	Hauling and piling baled hay	W. J. Kamman, Yuma, Ariz	1, 920. 00
	Region IV				
-59	Project planning	May 20	House trailer	Stout Trailer Sales, Salt Lake City, Utah	11, 970. 00
		do	do	D. T. Singer, Salt Lake City, Utah	8, 940. 00
	Region VI				
2	Region VI projects	May 27	Diamond core drill explorations, drive sampling, water pressure and percolation testing.	R. S. McClintock, Spokane, Wash	35, 800. 00
				Vivian Brothers, Kellogg, Idaho	31, 200. 00
	Project planning, North Dakota	do	Denison samplers	Modern Machinery Works, Bismark, N. Dak	1, 320. 00
	Region VII				
1943	Kendrick—Wyo	May 13	Relays	General Electric Co., Denver, Colo	1, 018. 76
499	do	May 16	Culvert	Pacific Corrugated Culvert Co	3, 832. 57
506	Colorado-Big Thompson—Colo., and Missouri Basin—Nebr.	May 27	Shower cabinets	Crane O'Fallon Co	6, 142. 50
633 a	Colorado-Big Thompson—Colo	do	4 inch black pipe	American Pipe & Supply Co	1, 847. 70
633 b	do	do	do	do	1, 556. 24
633 c	do	do	4 inch pipe	do	1, 262. 60
633 d	Colorado-Big Thompson—Colo., and Missouri Basin—Nebr.	do	3 inch seamless pipe	do	1, 926. 70

Valley Lifeline

(Continued from p. 155)

Corporation or large-scale farming is virtually nonexistent in the Coachella Valley where family-sized farms predominate. Ninety-two percent of the farms in the District are in sizes of 160 acres or less. The appeal of specialty production of dates and citrus fruit has resulted in the establishment of small holdings by enterprising individuals.

Coincidental with the growth of agriculture has been the rate of increase in the population of the valley, mostly rural. The number of residents climbed from 3,700 people in 1920 to 10,423 in 1940, the last official census year.

POWER PAYS FOR DAM SITE TOWN

Acting Secretary of the Interior Oscar L. Chapman has submitted to Congress a report under which the Federal Government would be repaid for its investment in the construction and operation of Boulder City, Nev. Boulder City—built by the Bureau of Reclamation at a cost of more than $1,355,000 to house workers during construction of Boulder Dam—has been maintained in connection with the operation of facilities of the dam.

Under present procedure costs are borne by the contractors who purchase the power developed at Boulder Dam. The output of Boulder Dam power plant is marketed under contract to nine allottees, the two largest being the Department of Water and Power of the City of Los Angeles and the Southern California Edison Company. Power revenues have exceeded $8,000,000 annually. The greater part of these revenues is deposited in the Treasury toward repayment of project costs.

The report contains a recommendation that the power contractors should continue to pay part of the cost of Boulder City's construction, operation and maintenance. The remaining costs, attributable to other Federal Agencies and general public occupation, will be deferred until 1987.

MODEL OF A GIANT—*Engineers study the operating characteristics of the proposed 482-foot high Bhakra Dam, huge multiple-purpose project which will harness the waters of the Sutlej River in Punjab Province, India, to provide irrigation, power, and flood control. Recently completed at the Denver laboratories of the Bureau of Reclamation, the model was built on a scale of 1 to 80 for the International Engineering Company, a private engineering firm which has been commissioned by the Government of India to prepare the designs. R. F. Blanks, Chief of Bureau Research, is pointing out the operations of the overflow spillway to (left to right) Jacob E. Warnock, Chief of Hydraulics Laboratory; John L. Savage, Consulting Engineer; and Dr. H. L. Uppel, Government engineer from Punjab.*

Jobs in the Making

Hundreds of thousands of veterans will shuck their uniforms and go to work in the big job of developing the land and water resources of the West during the next 5 years.

Jobs for more than 460,000 workers, it is estimated, will be provided at the construction sites and indirectly in the settlement and power programs, in the manufacture of materials and equipment, in transportation, and in other related activities stemming from the vast Bureau of Reclamation program as planned through 1951.

Construction now programmed on 82 authorized irrigation and multiple-purpose projects in the 17 Western States during the 1947–51 period will result in more than 316,500 man-years of employment.

Workers of all types of skill and training from professional engineers to equipment operators and laborers, will find a place in the construction program. Some of them will no doubt be able to carve permanent niches for themselves in contractor's organizations or in the Bureau of Reclamation itself.

Basinwide developments—the complete development of all the water resources of the arid areas of the west—call for large construction far beyond the close of 1951. Continuing employment for thousands of veterans and other workers now entering the field for the first time will result.

Veterans comprised about 50 percent of the total work-force required for completion of the 1946 fiscal year construction program. Of a total of 24,000 workers, about 12,000 were veterans.

Fiscal year 1947 will see the total employment figure more than double, according to estimates, jumping to 52,000 workers, of whom 39,000 probably will be veterans and approximately 13,000 non-veterans.

All figures and estimates assume availability of funds for authorized construction and reasonable availability of materials.

Fiscal year 1948 will see employment reach its peak during the 1947–51 period, with an estimated 127,500 workers employed in various phases of the construction program. Of these, it is believed that at least 95,000 will be veterans.

Employment during fiscal year 1949 will fall to around 124,500 workers, tapering to 87,000 in 1950 and to 49,400 in 1951.

The return of World War II veterans to farms has increased during the last few months. Approximately 50 percent of all farm draftees are now back on the farm, but few are returning as wage hands.

Everyone A Builder

This magazine is devoted to the upbuilding of the West. It is designed to bring pleasure and profit to you. It can bring similar pleasure and profit to your friend, neighbor or relative who does not yet receive it. The price is nominal—$1.00 a year. If you are an irrigator, the price is only 50 cents a year. You need allies in building prosperity for yourself and for your neighbors. Help build the circulation of the Reclamation Era *and thus multiply your allies.*

Gigantic Tunnel Under Way

A tunnel nearly two miles long, drilled through solid rock, is being built in connection with the accelerated program to bring irrigation water to the million-acre Columbia Basin project.

The tunnel will be 23 feet in diameter, large enough to admit a railway boxcar easily. Water stored by Grand Coulee Dam will flow through this huge tube to transform an arid area of 12,000 to 15,000 acres into productive farm lands.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users—Continued

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Lower Yellowstone	Board of control	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	do
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	do
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	do	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Philip Hiibel	Superintendent.	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr	President	Joseph R. Tudenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington, Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	Arlie S. Campbell	do	William T. Davis	Brigham City, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	H. J. Lawson	Superintendent.	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	do	E. F. Andrews	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo F. Clark	do	F. A. Baker	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hansen	Manager	A. R. Hansen	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1946—698792

Personnel and Project Directory

J. A. KRUG, SECRETARY OF THE INTERIOR

Commissioner's Office

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Clifford E. Fix, Chief Counsel; T. W. Mermel, Acting Assistant to the Commissioner—Engineering; G. S. Ellsworth, Assistant to the Commissioner—Management; Barrow Lyons, Chief Information Officer; William F. Kubach, Director of Finance; Glenn D. Thompson, Chief Personnel Officer; Kenneth F. Vernon, Progress Control Officer; C. A. D. Young, Director of Supply

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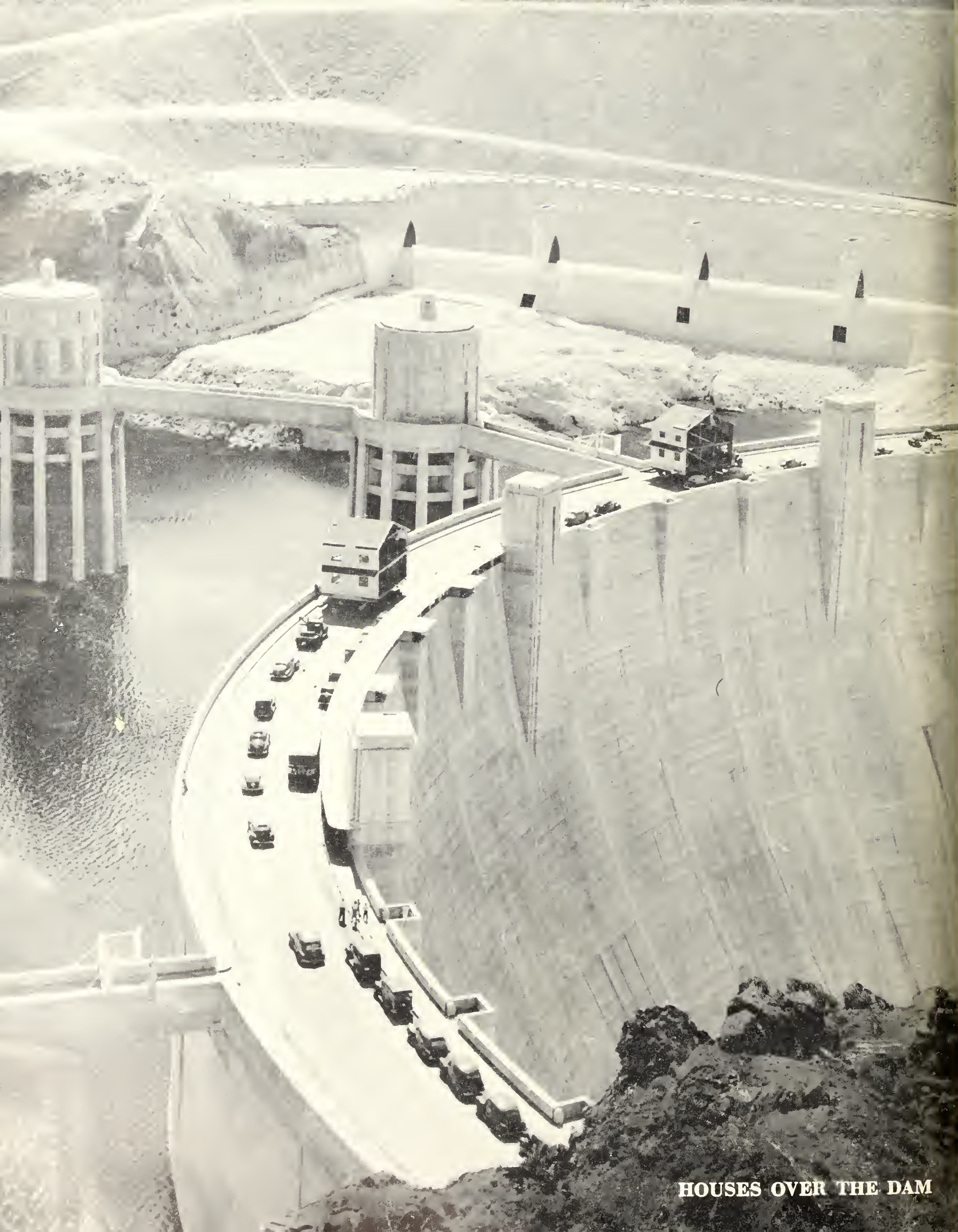
John W. Dixon, Director, Branch of Project Planning; Walker R. Young, Chief Engineer and Director, Branch of Design and Construction (Denver); Harvey F. McPhail, Director, Branch of Power Utilization (Washington); Goodrich W. Lineweaver, Director, Branch of Operation and Maintenance

Regions (Space does not permit complete list of offices within the regions)

Regional offices	Field offices	Location	Official in charge	
			Name	Title
Region 1—R. J. Newell, director, Boise, Idaho.	Central Snake (district).	Boise, Idaho	George N. Carter.	Acting district engineer.
	Anderson Ranch Dam.	Anderson Dam, Idaho.	Vacancy	Construction engineer.
	Deschutes	Bend, Oreg	C. H. Spencer	do.
	Yakima	Yakima, Wash	D. E. Ball	Superintendent.
	Roza division	do	H. T. Nelson	Construction engineer.
	Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Supervising engineer.
	Ephrata office	Ephrata, Wash	H. A. Parker	Engineer.
	Project development.	do	W. W. Johnston.	Acting supervisor.
	Minidoka	Burley, Idaho	S. R. Marean	Superintendent
	Palisades	Idaho Falls, Idaho.	I. Donald Jerman.	Project engineer.
	Hungry Horse	Kalispell, Mont	Paul A. Jones	do.
	Umatilla	Pendleton, Oreg	C. L. Tice	Reservoir superintendent.
	Rathdrum Prairie	Coeur d'Alene, Idaho.	Louis B. Ackerman.	Construction engineer.
	Bitterroot	Hamilton, Mont.	T. R. Smith	do.
	Missoula Valley	do	do	do.
Region 2—R. L. Boke, director, Sacramento, Calif.	Central Valley			
	Kennett division.	Redding, Calif	I. C. Harris	Acting construction engineer.
	Friant division	Friant, Calif	R. K. Durant	do.
	Delta division	Antioch, Calif	O. G. Boden	Construction engineer.
	Klamath	Klamath Falls, Oreg.	E. L. Stephens	Superintendent.
	Orland	Orland, Calif	E. R. Asdell	do.
	Project planning	Santa Barbara, Calif.	J. H. Fertig	Engineer.
Region 3—E. A. Moritz, director, Boulder City, Nev.	All-American Canal.	Yuma, Ariz	J. K. Rohrer	Acting construction engineer.
	Gila	do	do	do.
	Yuma	do	W. A. Boettcher.	Superintendent.
	Coachella Canal	Coachella, Calif	C. S. Hale	Division engineer
	Boulder Canyon	Boulder City, Nev.	C. P. Christensen.	Director of power.
	Davis Dam	Kingman, Ariz	H. F. Bahmeier	Acting construction engineer.
	Parker Dam Power.	Parker Dam, Calif.	S. A. McWilliams.	Construction engineer.
	San Diego	Escondido, Calif	R. B. Ward	Engineer
	Project planning	Phoenix, Ariz	V. E. Larson	Assistant regional planning engineer.
Region 4—E. O. Larson, director, Salt Lake City 8, Utah.	Eden	Rock Springs, Wyo.	E. V. Hillius	Chief clerk.
	Grand Valley	Grand Junction,	T. L. Sundquist	Superintendent.
	Mancos	Mancos, Colo	A. W. Bainbridge.	Resident engineer.
	Newton	Logan, Utah	E. J. Wick	Engineer.
	Pine River	Bayfield, Colo	S. F. Newman	Reservoir superintendent.
	Provo River	Provo, Utah	L. R. Dunkley	Construction engineer.
	Scofield	Price, Utah	P. R. Neeley	do.
Region 5—W. R. Nelson, director, Amarillo, Tex.	San Luis Valley	Monte Vista, Colo.	D. M. Forester	Project engineer.
	Valley Gravity	McAllen, Tex.	C. P. Seger	Area planning engineer.
	Tucumcari	Tucumcari, N. Mex.	M. P. Starr	Acting construction engineer.
	Altus	Altus, Okla.	H. E. Robbins	Construction engineer.
	Rio Grande	El Paso, Tex	L. B. Fiock	Project superintendent.
	Ysleta office	Ysleta, Tex	F. D. Postle	Division superintendent.
	Las Cruces	Las Cruces, N. Mex.	E. S. Mayfield	Do.
	Carlsbad	Carlsbad, N. Mex.	T. B. Thomas	Acting project superintendent.
Region 6—H. D. Comstock, director, Billings, Mont	Belle Fourche	Newell, S. Dak	S. T. Larsen	Superintendent.
	Buffalo Rapids	Terry, Mont	W. L. McClure	Acting construction engineer
	Fort Peck	Fort Peck, Mont	Allen Mattison	Resident engineer.
	Intake	Terry, Mont	W. L. McClure	Acting construction engineer.
	Milk River	Malta, Mont	H. W. Genger	Superintendent.
	Rapid Valley	Rapid City, S. Dak.	H. V. Hubbell	Construction engineer.
	Riverton	Riverton, Wyo	D. L. Carmody	Superintendent.
	Shoshone	Powell, Wyo	L. J. Windle	Do.
	Heart Mountain division.	Cody, Wyo	W. L. Kemp	Construction engineer.
	Sun River	Fairfield, Mont	C. L. Bailey	Superintendent.
	Missouri River			
	Project development staff.	Billings, Mont	W. E. Rawlings	Supervisor.
	Boysen Dam	Thermopolis, Wyo.	R. S. Lieurance	Project engineer.
Region 7—E. B. Debler, director, Denver, Colo.	Colorado-Big Thompson	Estes Park, Colo.	C. H. Howell	Do.
	Mirage Flats	Hemingford, Nebr.	D. J. Paul	Construction engineer.
	North Platte district.	Casper, Wyo	I. J. Matthews	District engineer.
	Missouri Basin			
	Frenchman-Cambridge.	McCook, Nebr	H. E. Robinson	Project engineer.
	Kortez (under North Platte district)	Casper, Wyo	I. J. Matthews	District engineer.
	Project planning	Grand Island, Nebr.	P. L. Harley	Engineer.
	do	Pueblo, Colo	B. F. Powell	Do.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D. G. Leslie	Superintendent.	C. J. McCormick	Grand Junction, Colo.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Norval T. Kitchen	Superintendent.	Lamont M Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.



HOUSES OVER THE DAM

August 1946

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OUR NEW HOME, DADDY?

THE *Reclamation* ERA

Reclamation ERA

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Contents

Front cover photograph by Stanley Rasmussen, photographer, region 1, Bureau of Reclamation. Back cover photograph by Paul E. Norine, general photographer, formerly of Region 2 now of Region 1, Bureau of Reclamation.

★

Lest We Forget

"Our own objectives are clear; the objective of smashing the militarism imposed by war lords upon the enslaved peoples—the objective of liberating the subjugated nations—the objective of establishing and securing . . . FREEDOM FROM WANT . . . everywhere in the world."

Franklin D Roosevelt

FAMINE EMERGENCY COMMITTEE

(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of ---------- for a -------- year subscription to the RECLAMATION ERA.

Sincerely,

Check (√) if member of water users association ☐

(Name)

(Address)

(Include zone number, if any)

(Name and address of association)

Lower-Cost Canal Lining Program

by ALFRED R. GOLZE, *Assistant Director, Branch of Operation and Maintenance*

As development of the West proceeds, there is becoming more apparent what has long been known to engineers—that the West's ultimate development cannot go beyond the maximum use of the waters supporting its agriculture and industry. Such uses may be for irrigation, mining, municipal supplies, hydroelectric power, or navigation. With only the runoff available from the rivers that drain the Rocky Mountains and the West coast, it is quite apparent that the greatest conservation of all the available water must be practiced if the West is to secure its fair share of the Nation's wealth and prosperity.

The Bureau of Reclamation is aggressively exploring all potential irrigated areas in the Western States to determine the best use of this limited resource. This program eventually will determine what new lands can be irrigated and what existing areas can receive a supplemental supply. To meet its objective, not only must all water not now in use be put to work, but water presently at work must be tested for its efficiency. It is this latter phase which is of much concern today to the engineers of the Bureau of Reclamation.

An irrigation farmer pretty much takes for granted the water running down the lateral or flowing smoothly through the main canal near his home. As long as enough water comes through the canals to meet his irrigation requirements, he is generally satisfied, though he may occasionally argue with his ditch rider about some of the details. It may not be apparent to some farmers that the ground through which this water flows exacts a tribute having far-reaching effects, because soil conditions can and do place a tax on the operation of irrigation systems that is just as real as the tax paid to the county or Federal Government each year. Unlike other taxes, it has no beneficial use and it is a millstone around the neck of future project developments. That this is so is proven by the records of the Bureau of Reclamation.

The concrete-lined Kittitas Main Canal, Yakima project in the State of Washington, carrying about 600 cubic feet a second of water. Looking downstream.

Water Losses Add Up

In the table on page 166 are cited figures presenting an average of 6 years' water records for a representative group of Bureau-operated projects. These figures show all too clearly the substantial losses in irrigation water which occur between the source of supply and the receiving farm.

In looking over this table, certain fundamental factors must be kept in mind:

Evaporation is an important loss in a canal of any length or breadth.

Transpiration from uncontrolled vegetation or trees on canal banks is responsible for part of the losses.

Waste from canal operations due to fluctuations in meeting delivery schedules causes unavoidable spilling of excess waters.

The greatest loss, however, is seepage or disappearance of usable water into the ground. The development of seep places on farm lands is an all too common occurrence on almost every irrigation project. Usually, they are adjacent to the canals or laterals, although in some areas, seepage may develop some distance from the distribution system where the subsurface formations provide subterranean passageways.

The loss of water in transit has been considered as inevitable for many years. Canals are actually designed to meet these losses by providing a greater capacity than is required for the amount of water needed to meet these losses by the farms, thereby increasing the cost of construction a substantial amount. The seepage of water from canals leads to development of poor plant conditions. Noxious weeds and other unwanted plants grow profusely over the seeped areas or the land becomes alkali and sterile. Good land goes out of production. The appearance of seepage leads to a demand for the construction of drains, which are installed at considerable additional cost, and the maintenance of an elaborate system of water channels becomes necessary. Unlined canals, laterals, and drains in themselves are good supporters of the stepchildren of the plant world. No small part of the annual budget of irrigation districts is used for the cleaning of vegetation and silt from canals and drains.

Obviously, if some way could be found to prevent the seepage of water from canals, many of the ills afflicting irrigation projects would be overcome. Good agricultural land would be kept in production. Unsightly and expensive drains would be reduced in size and extent. Maintenance of canals, laterals, and drains would be lessened and their appearance improved. But of equal importance, valuable water would be saved for use elsewhere. That the savings may be substantial is borne out by the table.

Equation For Economy

If the value of water can be approximated, it then becomes a matter of simple mathematics to determine the amount that can be economically spent on sealing a canal for any given cross section. For example:

Assume a 50-mile canal designed to carry 1,320 cubic feet per second with a velocity of 4.72 feet per second.

Its cross-sectional area $= \frac{1,320}{4.72} = 280$ square feet.

702884—46——1

Average annual acre-feet total water supply, water used on farms, water losses, and acres irrigated for the 6-year period 1940–45, inclusive, for 14 reclamation projects

Region	Project	Average total water supply (net supply for project or unit), acre-feet	Average annual losses						Water used delivered to farms		Average acres irrigated
			Canal losses		Lateral losses		Main canal and lateral waste				
			Acre-feet	Percent	Acre-feet	Percent	Acre-feet	Percent	Acre-feet	Percent	
I	Boise—Entire project	852, 247	52, 563	6. 2	212, 489	24. 9			587, 195	68. 9	166, 462
	Minidoka—Gooding Division (entire division).	398, 731	58, 466	14. 7					310, 265	85. 3	73, 037
	Owyhee—North canal gravity	283, 803	28, 745	10. 1	29, 941	10. 6	[1] 50, 200	17. 7	174, 917	61. 6	42, 011
	Yakima—Sunnyside	433, 245	16, 678	3. 8	58, 774	13. 6	24, 740	5. 7	333, 053	76. 9	81, 923
II	Orland—Entire project	94, 834	2, 767	2. 9	15, 647	16. 5	8, 166	8. 6	68, 254	72. 0	16, 040
	Klamath—Entire project	321, 819	53, 198	16. 5	82, 885	25. 8	15, 712	4. 9	170, 024	52. 8	80, 197
III	Salt River—Entire project [2]	1, 255, 802	256, 632	20. 4	191, 105	15. 2	13, 316	1. 1	794, 749	63. 3	[3] 242, 372
	Yuma—Valley and Reservation (combined).	408, 811			70, 581	17. 3	[4] 125, 291	30. 6	212, 939	52. 1	53, 000
IV	Uncompahgre—Entire project	548, 178	21, 552	3. 9	78, 764	14. 4	109, 439	20. 0	338, 423	61. 7	66, 433
V	Carlsbad—Entire project	100, 823	29, 149	28. 9	10, 198	10. 1	5, 888	5. 9	55, 588	55. 1	20, 498
	Rio Grande—Entire project	1, 021, 439	342, 860	33. 6			234, 277	22. 9	444, 302	43. 5	150, 928
VI	Belle Fourche—Entire project	81, 966	21, 010	25. 6	16, 221	19. 8	6, 121	7. 5	38, 614	47. 1	36, 219
	Lower Yellowstone—Entire project	280, 869	74, 296	26. 5	7, 880	2. 8	117, 468	41. 8	81, 225	28. 9	46, 700
VII	North Platte—Entire project	648, 588	214, 437	33. 1	122, 529	18. 9	12, 690	. 9	298, 932	46. 1	210, 235
	Total	6, 731, 155	1, 172, 353	17. 4	897, 014	13. 3	723, 308	10. 8	3, 938, 480	58. 5	1, 286, 055

[1] Includes water delivered to other canals. [2] For 4-year period 1942–45. [3] Acres irrigated in 1945. [4] Lateral waste.

With sides slopes of $1\frac{1}{2}:1$ and a 10-foot bottom, the radius = 4.6 and the wetted perimeter $= \frac{280}{4.6} = 61$ feet.

With a 1-foot freeboard on each side, the total perimeter = 63 feet.

If the canal in question has an annual inflow of 200,000 acre-feet and 25 percent of that inflow can be recovered by sealing, and if the water is considered to be worth $2 per acre-foot, the annual saving will be worth $100,000. At 3 percent interest, over a 10-year period (assuming the life of a line material to be 10 years), $100,000 will retire an investment of $2,311,479.

The Bureau can afford, therefore, to spend $2,311,479 to seal the 50-mile canal or $46,230 a mile, or $8.76 per foot of canal.

The allowable cost per square yard for lining will then be equal to $\frac{8.76 \times 9}{63} = \$1.25$.

In other words, a canal lining, good for 10 years, must be found which will not exceed $1.25 per square yard installed.

This example, of course, may not give sufficient weight to the extreme need for additional water now developing generally throughout the West. A close study of the economic factors influencing the value of water might result in the assignment of higher values, thereby justifying a greater expenditure for lining.

Seepage Problem Serious

Aware of the seriousness of the seepage problem, various irrigation organizations, State institutions, and the Bureau of Reclamation have made sporadic attempts to find a solution. Most of these skirmishes took the form of experiments with various types of sealing materials to determine their effectiveness in making canals watertight and to get some figures on their cost of installation.

Reinforced concrete has frequently been used as a lining agent. It meets most of the requirements of a good sealing material. It is durable, resists changes in weather, prevents the growth of vegetation and the occurrence of erosion. Its disadvantage is its relatively high cost. The economies of lining a big canal using the formula previously recited may support the use of reinforced concrete, particularly if machines can be used to place it, as shown in an illustration. Asphaltic concrete also may be justified on the larger canals. On small laterals, reinforced concrete is expensive because hand labor is generally used. Possibly the development of machinery and equipment which could effectively cut a lateral to its designed section, place reinforcing if required, and mix and pour the concrete all in sequence operations, would reduce costs to the place where concrete can compete with lower cost materials.

New Materials Tested

In addition to reinforced concrete, plain or unreinforced concrete, gunite, asphaltic concrete, and bentonite have all been tried, as well as soil-cement mixtures and plain clay or silt. Each of these materials has shown some degree of satisfactory performance, but as yet complete information has not been developed. With many, an experience over a period of years will be required to determine their effectiveness in withstanding extremes of temperatures and to accumulate reliable information on the cost of maintenance. Often the test sections were installed by hand labor which led to high unit cost. Other materials developed during the war for military purposes need to be tried as sealing agents on canals.

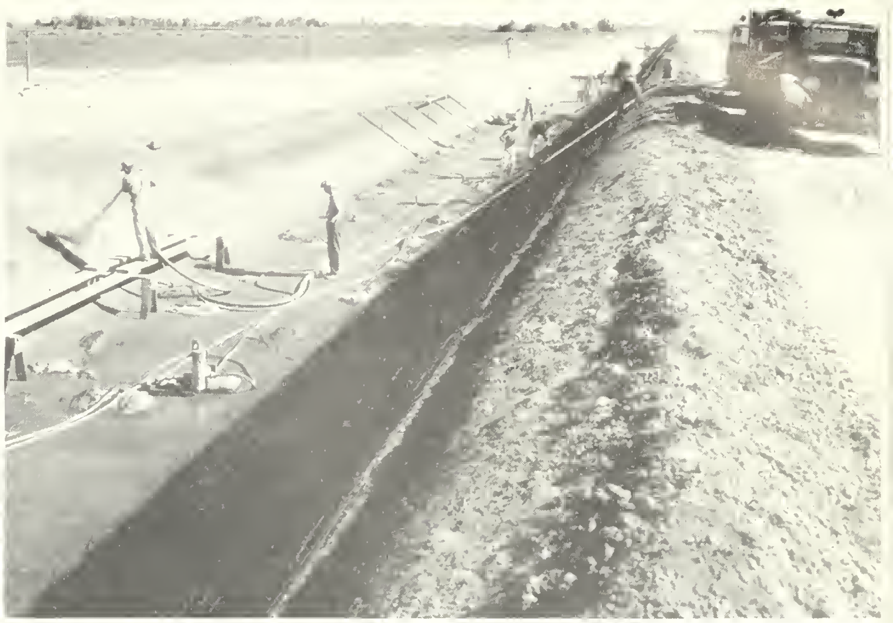
With the return of normal construction conditions, interest in effective sealing agents for irrigation canals and laterals began to grow. At the 1945 fall meeting of the National Reclamation Association the subject was discussed at some length. In December 1945, the Commissioner of Reclamation instructed his staff to prepare an aggressive program for his approval that would get results. In appearing before the House and Senate Appropriation Committees in the spring of 1946, representatives of the Bureau were questioned as to this program and plans for its financing. Justification was made to the Congress for use of a portion of the project construction appropriations to conduct a lower-cost canal lining program.

On March 6, 1946, the Chief Engineer and the Director, Branch of Operation and Maintenance, jointly submitted to the Commissioner—and he approved—a Bureau-wide program with the objective of determining the best materials to be used for lining of canals under the various conditions found in the irrigated areas of the Western States.

Every Angle Considered

Under the Bureau's approved program, the Chief Engineer will make provisions in his plans and specifications for construction of new canals and laterals, for inclusion of new types of lining materials in sufficient quantity not only to determine their effectiveness as sealing agents but to ascertain their cost when placed under contract conditions utilizing specially designed equipment. The laboratory of the Branch of Design and Construction in Denver is conducting wide-scale research of all possible materials suitable for the lining of canals. Materials found worthy of further testing by actual installation are being reported to the designing engineers for incorporation in the plans and specifications of new work. Every assistance will be given to

A canal lining machine in operation on the Roza Division, Yakima project.



Concrete lining being applied by gunite method to side slopes; the bottom section complete. All-American Canal System.

equipment manufacturers in the design of special machinery.

The Regional Directors are administratively responsible for the conduct of the program in the field. They are supervising a complete investigation of all special types of canal linings in existence on both Federal and non-Federal projects in each region, to determine as far as possible the effectiveness of linings installed in previous years. The Regional Directors are furnishing the Chief Engineer with all field information necessary for the design of canals and laterals requiring linings on new projects or where reconstruction is in progress on old projects.

The Branch of Operation and Maintenance correlates the activities of the seven regions and the Denver and Washington offices, and is responsible for seeing that the program does not lag in any area.

It is expected that, from time to time, reports will be publicized summarizing the results of the research and testing in progress. An interim report recently has been issued by the Chief Engineer summarizing the types of lining tested and results of work accomplished prior to the beginning of the Bureau's program. This interim report has been made available to Bureau regional offices. It is expected that the first progress report with detailed information will be issued in time for use in the 1947 construction season. This report is expected to complete cost data and tentative recommendations for types of canal linings to be used under varying conditions.

Data Ready in 1947

It is not expected that remarkable discoveries will be forthcoming, but the Bureau does hope to have available in usable form beginning in 1947, reliable technical and cost data on all known materials suitable in any way for sealing of irrigation canals. This information will not be completed by 1947, but must of necessity extend over a period of years so that actual experience in the field will show the ability of the various materials to perform, and the cost of maintenance. Progress reports will be issued from time to time and distributed widely to all interested irrigation organizations. The benefits from this program will not only be used to insure maximum use of water on new projects now under construction or planned for future use, but will be made available to the older projects, where through a rehabilitation program, it is expected much of the water now lost will be recovered.

Central Valley Project Earns $4,000,000 in 1945-6

California's Central Valley Project, in the first full year of operation of its earliest features, is already paying substantial dividends. Total earnings of the Project for the fiscal year just ending are approximately $4,090,202.

The Central Valley Project comprises a system of grand canals which will exchange water between water surplus and water-deficit regions, hundreds of miles apart, in the richest block of farm land on earth. Some 50 large dams will store the water which power plants will use to produce electricity for irrigation pumping and for industrial use. Main features of the project now in operation are Shasta and Friant dams, the former the second largest dam in the world, presently generating 150,000 kw of electric power.

Sale of power from Shasta Dam is the biggest single item in the year's balance sheet, followed by water sales, rental of buildings, rent of the Shasta-Oroville power line, and leases of grazing lands in the foothills above Shasta and Friant dams. Income for 1945–46 breaks down as follows:

Power Sales	$3,678,224
Line Rental	75,000
Lease of Grazing Lands	3,421
Miscellaneous (including rental of buildings)	100,750
Water Sales	232,807
	4,090,202

(Continued on p. 170)

This section of the main canal on Rathdrum Prairie project, Idaho, is lined with a 6-inch compacted layer of clay covered with a 6-inch layer of gravel.

How Policy is Made in Planning an Investment for America

ADVENTURES OF A BUDGET

by KENNETH MARKWELL, *Assistant Commissioner of Reclamation*

When the Bureau of Reclamation prepares a budget it plans an investment for the American people—one of the most productive investments the people can make. Each citizen profits directly or indirectly from this investment in western irrigation and related hydropower facilities that enhance the feasibility of the nation's resource development. Every dollar that is invested increases national income by making possible expansion of agriculture and industry. New farms, new homes, new business enterprises are erected. Such extension of productive enterprise multiplies markets for farm and industrial products produced in every section.

Behind the drafting of a Reclamation appropriation bill, however, there goes on every year a struggle between many conflicting schools of thought.

Congress Votes 90 Percent

During the fiscal year 1947, which began last July 1 and ends June 30, 1947, the Bureau of Reclamation will have appropriated funds to make the biggest investment for the American people it has ever made in one twelve-month period. For this year Congress voted $113,610,803 of which more than 90 percent is for the expansion of Reclamation projects—the largest Reclamation appropriation it every made in one bill. In addition there was a carryover of funds from the last fiscal year of about $90,000,000, which gives the Bureau more than $200,000,000 to spend on western development during the year.

When all of the presently authorized, but uncompleted projects are finished, they will represent a Federal investment of about $1,800,000,000 in dams and reservoirs, canals, power houses, and transmission lines, which will be added to existing Bureau properties valued at nearly $1,000,000,000 already serving the people. These enterprises in 1945 produced crops valued at $435,181,395 and more than 13 billion kilowatt hours of electric energy.

Preparation of the great budget for this year's program involved unusually difficult problems. While engineers and economists of the Bureau throughout the West were studying proposed projects to determine how much money would be required to construct them and whether they were economically feasible, Bureau officials in Washington and members of Congress were working over large supplemental appropriations for the 1946 program. The supplemental budget for 1946 finally was revised and appropriations made on December 28, 1945. The 1947 program was then adjusted to over-all policy of the Department of the Interior and the Bureau of the Budget, and a 1947 budget was transmitted to the Congress by the President in his message to Congress in January 1946.

This budget recommended appropriations of $167,212,455. After the proposed expenditures had been reviewed thoroughly by the House Appropriations Committee and debated on the floor of the House, the amount had shrunk to $72,271,475. But there were many people throughout the West who wanted projects built by the Bureau—and wanted them badly enough to make themselves heard before the Senate Appropriations Committee. So the Senate, expressing its concern for expanded veteran settlement opportunities and employment in approving its committee's report, restored $85,162,440 removed from the appropriation bill, and added $13,916,930 more—a total of $171,350,845.

Funds Tailored

According to custom, Congress then named a conference committee of the House and Senate. The conference committee agreed on adjustments in a report and the bill, after finally passing both houses, was signed by the President on July 1.

Making appropriations involves much more than the voting of funds. It means deciding upon policy also. During the discussions which take place before the House and Senate Appropriation subcommittees, and in the debate on the floors of both houses, policy is in the making—policy which will determine the shape of the whole Reclamation program. This policy also determines to a considerable extent which people are to benefit most directly from the vast construction effort which is to follow; whether irrigation is to be expanded to provide settle-

KENNETH MARKWELL

ment opportunities on Reclamation farms for war veterans, and whether there will be a public power program, to assist in advancing irrigation, and how rapidly progress on the program of developing the West is to be pushed.

The manner in which this comes about can best be seen by following several specific items through the congressional mill.

Take, for example, an item of $11,000,000 for general Bureau investigations recommended in the President's budget. The Bureau today is studying plans for coordinated water and land resource development in all of the great river basins of the West. In each one of these areas there will be established eventually developments that equal or surpass that of the Tennessee Valley Authority.

There are some who wish future river basin development to be conducted by valley authorities—government corporations like the Tennessee Valley Authority. Others believe that cooperative action between existing Federal agencies, States and local political units as the Bureau of Reclamation and other agencies are now doing can accomplish all that can be done by such authorities. But whatever ultimate form of administration may be used to bring about coordinated resource development, the reports on basins being made by the Bureau of Reclamation will provide the basic pattern for the resource development of the West.

The Interior Department and the Bureau of the Budget believed that $11,000,000 was not too great a sum to spend during the next year in formulating plans for western river basin development. This was an increase of $7,750,000 over the 1946 appropriation for that purpose and was intended to enable the Bureau to keep pace with its rapidly expanding program. It was in accord with the President's message on the state of the Union which declared: "The strength of our Nation and the welfare of our people rest upon the natural resources of our country . . . The first step in the Government's conservation program must be to find out just what are our basic resources and how they should be used . . . Our public works program should be timed to reach its peak after demand for private construction has begun to taper off. Meanwhile, however, plans should be prepared if we are to act promptly when the present extraordinary private demand begins to run out.

The House Appropriations Subcommittee reduced the fund for general investigations to the amount allowed for the previous year—$3,250,000. It expressed the opinion that the reduced amount plus a carry-over of about $1,500,000 provided an adequate program. In testimony before the Senate committee the Bureau testified that "this drastic reduction jeopardizes the success of the Bureau's planning program." The basin studies, many of which are nearing completion, would be retarded, it was asserted. The Senate restored the full amount, but the conference committee reduced the item to $5,000,000.

Bureau Salaries Cut

Another important policy was involved when the budget estimate of $5,500,000 for central administrative salaries and expenses was cut to $4,000,000.

Perhaps one of the most important domestic matters with which the Congress was faced during the course of its consideration of the 1947 appropriation bill had to do with the extent to which it would adhere to the established public power policy. To what extent should the Government develop the power resources of its rivers incidental to the primary uses of western water resources for irrigation? Should it sell most of the power its plants generate directly to the private utilities, or should it adhere to the enunciated congressional policy of giving preference to municipalities and cooperatives. Private utilities for many years have resisted the growth of public power systems, but the need of war industries for more power led to a rapid expansion of power generation by public agencies.

The power delivered to war plants by the Tennessee Valley Authority, the Bonneville Power Administration, the Southwestern Power Administration, and the Bureau of Reclamation were vital factors in winning the war. The three last-mentioned agencies are in the Department of the Interior. During the war the Bureau of Reclamation became the largest producer of power in the world.

The key decision in development of public power lies in who is to own and operate the transmission lines that carry power from the generators to the wholesale customers—the private utilities or the Government? Private utilities contend that it is uneconomical for the Government to sell public power over public transmission lines to public agencies, such as municipalities which have been operating their own distribution systems, and to REA cooperatives. The Government agencies entrusted by the Congress with producing most of the public power maintain that only by owning their own transmission lines can the people obtain the full benefits from their investment.

The net result of congressional action upon the Bureau of Reclamation appropriation bill was to eliminate many of the appropriations for transmission lines, but not all of them. Items for the vital transmission lines in the Central Valley project of California best illustrate one phase of current policy on which the House and Senate differed widely.

BUREAU OF RECLAMATION APPROPRIATIONS

Fiscal year 1947 construction funds by States and project, remaining funds for purpose

State and project or purpose	Budget estimate 1947	As reported to House	As reported to Senate	Public Law No. 478, 79th Cong., 2d Sess.
Construction total	$123, 814, 800	$52, 085, 355	$126, 445, 208	$84, 287, 368
Arizona—total	17, 075, 000	7, 421, 280	18, 575, 000	9, 575, 000
Gila	2, 000, 000	867, 210	3, 500, 000	2, 000, 000
Davis Dam (Arizona-Nevada)	15, 000, 000	6, 504, 070	15, 000, 000	7, 500, 000
Colorado River Front and Levee System (Arizona-California)	75, 000	50, 000	75, 000	75, 000
California—total	30, 700, 000	13, 224, 945	28, 036, 670	17, 785, 622
Central Valley	25, 000, 000	10, 810, 120	20, 836, 670	12, 685, 622
Kings River	200, 000		200, 000	100, 000
All American Canal (Arizona-California)	5, 500, 000	2, 384, 825	7, 000, 000	5, 000, 000
Colorado—total	17, 800, 000	7, 154, 485	14, 950, 410	9, 454, 485
San Luis	1, 500, 000	650, 410	650, 410	650, 410
Colorado-Big Thompson	15, 000, 000	6, 504, 075	13, 000, 000	7, 504, 075
Mancos (WCU)	1, 300, 000		1, 300, 000	1, 300, 000
Idaho—total	7, 920, 000	3, 434, 150	8, 129, 659	5, 667, 544
Boise, Payette division	2, 573, 000	1, 115, 660	2, 782, 659	2, 782, 659
Boise, Anderson Ranch	2, 847, 000	1, 234, 475	2, 847, 000	1, 234, 475
Minidoka	1, 000, 000	433, 605	1, 000, 000	1, 000, 000
Palisades	1, 500, 000	650, 410	1, 500, 000	650, 410
Montana—total	3, 096, 000	1, 342, 440	3, 096, 000	1, 841, 728
Sun River	96, 000	41, 625	96, 000	41, 625
Hungry Horse	2, 000, 000	867, 210	2, 000, 000	867, 210
Fort Peck	1, 000, 000	433, 605	1, 000, 000	932, 893
Nevada—total	1, 000, 000	433, 605	1, 000, 000	433, 605
Boulder Canyon (Arizona-Nevada)	1, 000, 000	433, 605	1, 000, 000	433, 605
New Mexico—total	2, 569, 800	1, 114, 280	2, 569, 800	2, 098, 675
Rio Grande (New Mexico-Texas)	831, 800	360, 675	831, 800	360, 675
Tucumcari	1, 738, 000	753, 605	1, 738, 000	1, 738, 000
Oklahoma—total	2, 080, 000	901, 900	2, 664, 610	2, 664, 610
Lugert-Altus	2, 080, 000	901, 900	2, 664, 610	2, 664, 610
Oregon—total	1, 925, 000	780, 485	3, 123, 442	3, 123, 412
Deschutes	1, 300, 000	563, 685	1, 716, 837	1, 716, 837
Owyhee (Oregon-Idaho)	125, 000	(1)	125, 000	125, 000
Klamath (Oregon-California)	500, 000	216, 800	1, 281, 605	1, 281, 605
Texas–total	68, 400	(1)	68, 400	68, 100
Colorado River	68, 400	(1)	68, 400	68, 400
Utah—total	3, 164, 000	1, 371, 925	4, 664, 000	1, 407, 040
Provo River	3, 102, 000	1, 345, 040	4, 602, 000	1, 345, 040
Ogden River	62, 000	26, 885	62, 000	62, 000
Washington total	31, 440, 600	13, 632, 795	29, 997, 100	20, 597, 100
Yakima, Roza division	1, 440, 600	624, 650	2, 597, 100	2, 597, 100
Columbia Basin	30, 000, 000	13, 008, 145	27, 400, 000	18, 000, 000
Wyoming—total	4, 976, 000	1, 273, 065	9, 570, 117	9, 570, 117
Kendrick	500, 000	216, 800	1, 895, 000	1, 895, 000
Riverton	1, 500, 000	650, 410	3, 520, 550	3, 520, 550
Shoshone, Heart Mountain	800, 000	346, 885	1, 917, 672	1, 917, 672
Shoshone, Willwood	136, 000	58, 970	196, 895	196, 895
Eden (WCU)	2, 040, 000		2, 040, 000	2, 040, 000
Missouri River Basin [2]	23, 908, 600	10, 312, 685	25, 582, 202	17, 500, 000
Operation and maintenance:				
Authorized from power revenues	3, 439, 945	3, 137, 445	3, 137, 445	3, 137, 445
Appropriated funds [3]	2, 489, 055	2, 323, 435	2, 323, 435	2, 323, 435
Salaries and expenses	5, 500, 000	4, 000, 000	5, 500, 000	4, 000, 000
General investigations [3]	11, 500, 000	3, 550, 000	11, 500, 000	5, 500, 000
Total direct appropriations	167, 212, 455	72, 271, 475	171, 350, 845	113, 610, 803
Total authorized from power revenues	3, 439, 945	3, 137, 445	3, 137, 445	3, 137, 445

[1] Estimate submitted when legislation was introduced in the Senate.

[2] Breakdown of construction funds by States is not available. Only breakdown available is of Budget estimate appropriations by purpose, and is as follows:

Construction and related work	$18, 693, 600
Investigations	2, 000, 000
Coordination with Corps of Engineers	150, 000
To be allocated among other Departmental units	[4] 3, 065, 000
Total	23, 908, 600

[3] Operation and Maintenance appropriated funds includes appropriations from Reclamation Fund, Colorado River Front Work and Levee System Fund, and Colorado River Dam Fund. General investigations include Reclamation Fund and Colorado River Development Fund.

[4] 125,000 of this aggregate was submitted when legislation was introduced in the Senate.

The Central Valley project appropriation as a whole was reduced from $25,000,000 included in the President's budget message to $10,810,120 in the House, and was restored on the floor of the Senate to the full amount requested. But in conference a compromise was worked out at $12,685,622, about half of the budget estimate. The power lines which would traverse the west side of the Sacramento Valley to bring Shasta Dam power to load centers in the Delta region are the vital link which can bring low-cost public power to cities and cooperatives in California. Officials of the Pacific Gas & Electric Co. opposed these lines. Bureau officials defended them. The House virtually eliminated the lines. The Senate restored them. In conference they were again curtailed. The Bureau may now find itself with only one customer bidding for its Central Valley power, although this power might have been delivered to the municipalities and cooperatives of California by their Government at rates which excluded profit to the private power company. On the Central Valley project a primary objective of the transmission system is to carry power for irrigation project pumping purposes from Shasta and Keswick Dams to the load centers in the Delta region.

Power Policy Debated

Transmission lines in the Missouri River Basin fared better. For planning and construction in the basin, the budget request was $23,908,600. The House cut this to $10,312,685, eliminating the Thermopolis-Boysen Dam transmission line and the Sidney, Nebr.-Gering, Nebr., line. The Senate restored the item to the requested amount and added $1,673,602 more. In conference the total was reduced to $17,500,000, but the transmission lines were permitted to remain intact.

One other specific item should be mentioned. The Mexican Water Treaty provides that Davis Dam, construction of which has just been begun—67 miles below Boulder Dam—should be built within 5 years. Total cost is estimated at about $76,000,000. The Bureau requested $15,000,000 for construction work in fiscal year 1947. At that rate, the dam could be finished on time. Congress cut the amount in half.

One of the situations which concerned members of the House Appropriations Committee arose out of the fact that on January 1, 1946, there was available more than $140,000,000 for construction work which had not been used by the Bureau. Testimony before the committee brought out that on December 28, 1945, approximately $81,000,000 was made available to the Bureau in a supplemental appropriation to launch its postwar program. At that time, there already was an unexpended balance of $59,000,000.

The final action of the Congress on the Bureau of Reclamation's program has left it unbalanced in a number of respects. Reduction of appropriations on major projects such as the Columbia Basin, Central Valley, Colorado-Big Thompson, and Missouri River Basin Projects may make it necessary either to seek supplementary appropriations, slow down construction, or in some cases shut down operations until additional funds are made available.

Veterans Favored

On the other hand, the Congress took a vital interest in those projects which would make possible veteran settlement. For most of these, more funds were appropriated than were requested in the President's budget message. Such projects are the Gila project in Arizona, the Minidoka project and the Payette division of the Boise project in Idaho, the Lugert-Altus project in Oklahoma, the Deschutes project in Oregon, the Klamath project in Oregon and California, the Roza division of the Yakima project in Washington, the Heart Mountain and Willwood divisions of the Shoshone project in Wyoming, and the Kendrick and Riverton projects also in Wyoming.

The Senate Appropriations Committee in its report placed special emphasis on the settlement and predevelopment program of the Bureau in the following language:

"The committee, during the hearings, admonished representatives of the Bureau of Reclamation as to its responsibility for providing as speedily as appropriations permit the maximum number of irrigated farms on reclamation projects for the settlement of returning war veterans. The Bureau was cautioned that the committee felt that the size of public-land farms should be examined closely and that due consideration should be given to all factors, including the Federal investment for each individual farm, so that settlement opportunities could be extended to as many veterans as possible.

Predevelopment Praised

"The committee notes with approval that the Bureau has included in the estimates submitted to the House and Senate, and has programed under project development the expenditure of limited construction funds on a reimbursable basis for clearing and rough leveling and the roughing in of farm ditches on public lands, and for advice, assistance, and information to all new settlers on public or private land in cooperation with State colleges. These types of work are essential to give veterans and other settlers a quicker start toward bringing their farm units into production. These activities protect the Federal investment through aiding the settler to begin repayment of construction charges much sooner than if he were deprived of such assistance in the preliminary development of an irrigated farm and properly are part of the reimbursable construction costs of the projects.

"The committee also renews its recommendation to the Bureau of Reclamation that in its own employment and, so far as it can bring the matter successfully to the attention of contractors, that preference be given to veterans who indicate a desire for and who are qualified for settlement on the project lands to be served by the systems under construction."

In some instances, it may be difficult to push construction on these projects rapidly enough to use within the fiscal year all of the funds made available.

The Bureau of Reclamation is pressing its program with all facilities available. However, over-all Federal policy may call for establishment of personnel ceilings on every department, in which case a limiting factor will have been imposed.

Results Summarized

To summarize: Approval has been given to a reclamation program twice as large as ever before. Projects to assure early settlement and other economical construction will be speeded to the limit. Construction on some of the largest projects may be slowed down, and the settlement program on the Columbia Basin project will necessarily be delayed beyond the 1950-51 goal of 400,000 acres of irrigated land. Planning for future work must move more slowly than was contemplated.

CVP Earnings

(*Continued from p. 167*)

Almost all the power distributed was sold wholesale, under a temporary wartime contract, to the Pacific Gas and Electric Company at Shasta Substation near Redding, and at Oroville. Small additional amounts were used by the construction company at the dam itself, at pumping stations on the Contra Costa Canal, and at an experimental steel plant at Shasta Dam where the Bureau of Mines is developing standard steel and new alloys from California and Oregon iron, manganese, and chromium. (See page 97: May 1946 *Reclamation Era*.)

Largest single purchaser of water has been the Contra Costa County Water District, which paid the Bureau $40,000 last year. This district was the first organization in the State to get CVP (Central Valley Project) benefits, when it contracted for the output of the Contra Costa Canal just after the main canal was finished in 1940. The canal now waters farm lands, and supplies municipal water in the area around Martinez, Antioch, and Pittsburg, on upper San Francisco Bay, and supplies industrial water to the big Columbia Steel and Shell Oil plants nearby.

Motors Over the MISSOURI

by R. L. BRANAM*

Vernon Baird, Jr., wartime test pilot, holds his oxygen mask as he prepares to warm up twin engines before flying to altitudes in excess of 30,000 feet to photograph vast acreages of the Missouri Basin.

MOTORS over the Missouri River Basin are reducing weeks to hours in the unprecedented task of mapping the thousands of square miles contained in the resource development program now under way.

Cutting foot work by staggering amounts, the Fairchild Aerial Surveys, Inc., of Los Angeles, is taking aerial photographs of 11,673 square miles of land in nine units of a plan to utilize to the fullest extent the water resources of the Missouri River Basin. The areas, in Montana, Wyoming, North Dakota, and South Dakota, are within the boundaries of Region VI, Bureau of Reclamation.

High-powered aircraft, winging through cloudless skies and flying at altitudes often in excess of 30,000 feet, are undertaking to furnish the Bureau of Reclamation with rectified aerial views, suitable for use as a basis for land development and water control.

The Fairchild concern was awarded a contract in the latter part of April for aerial photographs of a 98-square-mile area in the Grand River Unit in South Dakota, a 1,550-square-mile area in the Missouri-Souris Unit in Montana, 3,200 square miles in the Missouri-Souris Unit in North Dakota, 875 square miles in the Sun River-Teton Basin in Montana, 650 square miles along the Powder River in Montana, 700 square miles along the Powder River in Wyoming, and 400 square miles along the Tongue River in Wyoming.

In May, the same concern submitted bids for aerial topographic maps of the Tongue, Powder, and Clarks Fork River Basins in Montana and Wyoming, a combined area of 4,200 square miles.

On June 11, a Lockhead P-38 equipped for aerial photography arrived at Billings, Mont., to attempt a task never before undertaken in the field of commercial aerial photography—taking pictures at an altitude of approximately 30,000 feet from a plane flying 325 miles an hour.

This ship, piloted by Vernon Baird, Jr., with George William Sutphin operating the camera, completed the photographic operations on the Tongue, Powder, and Clarks Fork River Basin regions in nine flying days, at approximately 1 hour a day.

Baird, considered by Fairchild to be the top man in his field, explained that planes used for this work previously flew at altitudes in the neighborhood of 16,500 to 20,000 feet but, by seeking greater altitudes, the camera scope was increased and with faster speeds the task accomplished in far less time.

Sutphin, one of many former servicemen who gathered experience in the flaming skies over Europe, has been employed as a cameraman by the surveys company since 1945, when he was released from duty as a bombardier and navigator in the Army Air Corps. Baird has been employed by Fairchild since 1938, with the exception of one year spent as a test pilot for Lockheed Aircraft.

Two crews have arrived at Williston, N. Dak., to begin photographing the Missouri-Souris Unit in North Dakota and Montana, with work expected to be completed on the 4,750 square-mile area by the end of the year.

Handling the controls on the AT-6 is Joseph Pimentel, a former Army Air Forces captain who served with distinction in the European theater. His last assignment was flying supplies to General Patton's army in its drive across France and Germany. Henry Lloyd Ford, 5 years an Army Air Forces photographer, is operating the camera.

Pilot of the other plane, a Beachcraft, is Paul Stiles. Another plane to be assigned to Williston will be flown by Fred William Binger.

Before starting flights, maps with designated flight lines are formed. These flight lines are so placed as to allow for proper overlap of pictures and other technical aspects of the flight itself.

Directly after exposure, the film is taken from the plane and rushed to the laboratory for development and checking in order that any necessary reflights can be performed while the plane is in the area. An assembly of contact prints is then made for use as an index to the flying.

The next step is preparation of a mosaic. Ordinarily a satisfactory mosaic can be prepared by utilizing existing control stations or by establishing a few additional stations to increase the strength of the existing control network. A projection is made on masonite boards and all control plotted thereon. Slotted templates then are prepared and assembled on the projection. Following

The Vertical Mapping Camera.

* Bureau of Reclamation, Region VI, Billings, Mont

Preparation of the Mosaic.

Indexing Photographs.

the adjustment of the templates to fit the plotted control, the position of print centers and auxiliary points are marked. The aerial photograph is then made larger or smaller with tilting adjustments so that it will fit the positions as plotted by the template laydown. The mosaic then is titled and copied in sections, either on glass plates or sheet film, from which the required reproductions are made.

In the preparation of mosaics for use as planetable sheets, the photos are sent to a field survey department for identification and marking of all section and quarter-section corners. The pictures are returned to the laboratory with a General Land Office plat of the area.

From this plat the laboratory computes the horizontal coordinates for all the identified corners and plots these points on a projection prepared on the masonite board. After additional computations, rectified prints are made to fit the points and assembled into mosaic form.

If topographic maps are desired, a study is made of each photograph and topographic features are selected, for which horizontal and vertical positions are determined by field survey methods.

The control points thus established and identified are then plotted on individual sheets. After the original aerial film has reached the proper stability, contact glass positive plates are prepared. Using the control points plotted on the projection sheets, stereoscopic pairs, or "models" consisting of two glass positive plates, are adjusted in the stereo-plotting machine and the contours and planimetry are drawn by the Zeiss Stereoplanigraph. The lines drawn by the Stereoplanigraph then are traced with ink and the topographic map is ready for delivery.

Topographic maps will be made on the Tongue, Powder River, and Clarks Fork River areas, while work on the remaining projects, 7,473 square miles, will stop at the aerial photography stage.

Thus, as part of detailed studies of land topography and land classification, motors over the Missouri will save untold thousands of man-hours. They will expedite the progress of the Bureau of Reclamation in building a vast network of projects in the Missouri River Basin to furnish water for irrigating heretofore useless land and economical electric power for the profit and comfort of the thousands of persons living within the reaches of the river basin.

This photograph is copied from a mosaic showing the site of the Tiber Dam on the Marias River and a part of the reservoir area. The arrow points to the dam site. This view includes elevation symbols used later in the preparation of topographic maps.

Saga of Arizona's Fight for Water

VALLEY OF THE SUN

by JONREED LAURITZEN, *Author of "Arrows Into the Sun"*

Part II in a story of the conquest of drought

In Part One the early beginnings of irrigation were traced from the Ancient Days through the era of the Hohokam—a Southwestern Indian tribe in the Salt River Valley in Arizona—up to the time pioneers and settlers began to wrest a precarious living from the Valley of the Sun. In 1887, came the drought. Some settlers left, others turned their cattle loose and waited for rain, but the hard-willed ones who had licked Apaches and Comanches and distance and weather made up their minds that they would lick this drought too.

They began to hold meetings. The Maricopa County Board of Trade selected a committee to study water storage possibilities. Men rode over the sun-beaten hills, followed the course of rivers, stepped-off the valleys, put a level eye on the grades. Finally, in 1889, the county surveyor, W. M. Breakenridge, with John Nortan and James McClintock, found a large basin with a narrow, rock-lined gorge below it, in the course of the Salt River. This was the dam site.

A mass meeting was called for Friday, August 31, at 10 a. m. On that morning every saddle horse and rig in the valley was tied outside the Dorris Opera House, while, inside, men argued this thing of a reservoir to cost $2,000,000.

First, Territorial Governor Murphy had a plan. They should ask the Federal Government to cede to the territory all public lands within its borders, which they then would sell to pay the cost of the dam. The farmers objected. That would take time. There ought to be a dam in that river, and pronto, if they were going to save next winter's water.

Somebody then proposed that the county bond itself to pay the cost of the dam. But now the canal companies wanted $4,000,000 for their holdings. That would bring the cost of the project to over $6,000,000. The total assessed valuation of the county was only $10,000,000.

Captain W. A. Hancock stood up then and made a little history by proposing that a company be formed to store and develop water for 275,000 acres, and that each owner should be assessed $10 an acre to pay the cost, and that each city owner should pay 5 percent of the value of his property.

That brought no relief to the tense, sweating faces of the farmers. It took Sam Webb to relax them. He got up and spoke, quite seriously, of bringing Colorado River water into the Salt River Valley!

"Ay—" Chairman McGowan shouted, good naturedly, "and we'd only have to dig a canal 7,000 feet deep and 200 miles long—and we could sure have it done before Christmas!"

A permanent diversion dam was built at Granite Reef. Then the water flowed out upon the thirsty land.

The meeting ended in the appointment of another committee. This committee went to work on the Territorial Legislature and obtained an appropriation of $30,000 for preliminary work.

The committee at length concluded that the county should bond itself and that all the land in the county should bear its pro rata share of the project's cost, as Captain Hancock had proposed. They picked B. A. Fowler to go to Washington and persuade Congress to allow Maricopa County to bond itself.

Many Easterners never had heard of irrigation. Some Congressmen threw up their hands in dismay at this proposal to thwart the plans of nature. Fowler tried to tell them about the British in India, where an investment of $360,000,-000 had reclaimed 35,000,000 acres of land and saved 50,000,000 people from recurrent famine. But Congress would not listen. If Arizona must have its project, let it be financed privately—maybe by those who had made fantastic fortunes out of her mines. There must be no precedent set up which would put the Nation on a "wild spending spree."

Fowler was about to pack his satchel and go home, when he happened to meet a young lawyer-engineer named George H. Maxwell. The possibilities of this Arizona enterprise must have gone strongly to Maxwell's head, already full of its own tinder and ready to be ignited by a vision of vast deserts made to blossom through the instrumentality of man. Evidently Maxwell had practical judgment and persuasive power to go with his spark of vision. Under his eloquence Congressional minds began to reconsider. Representative Newlands of Nevada joined with him in preparing a reclamation bill.

Then at the right time, for Maricopa County at least, fate put Theodore Roosevelt in the White House. Roosevelt had a high regard for the West, where he had spent some happy days. Arizonans had given his Rough Riders a good deal of their frontier strength and daring. It was not difficult for Roosevelt to see the light of reclamation. Roosevelt was astute enough to see that the only way the immense, semiarid acreages of the West could be developed in a rapid and orderly fashion was by a wise and bold program of public expenditures, with adequate provision for paying off the debt. So he urged Congress to pass the reclamation bill.

On June 17, 1902, with a cheerful showing of teeth, the President signed the Hansbrough-Newlands Act. It began a series of public works that not only changed the face of the Salt River Valley in a few years, but altered the economy of the whole West and may yet bring its rivers completely into harness and millions more acres of its lands under cultivation.

When Phoenix got news of the signing

of the reclamation bill it went wild. It shouted itself hoarse, it bloomed with torchlight parades.

But the reclamation bill could not in itself grow alfalfa. There were many problems to be solved before the dam could be built. Many people had land but no water rights, others had water rights and no land. Some were unwilling to sign agreements that would make them liable for their pro rata share of the project's cost. It took months of argument, persuasion, study and legal work to get everything in shape to proceed with the actual work of construction.

Before the dam could be built, 65 miles of road had to be constructed through the hills to the site. A narrow-gage railroad was built to haul limestone and clay from the mountains above the dam site—for the cement for the dam was to be made on the site. The lumber to be used was also sawed on the spot. Other materials and supplies had to be hauled by wagon from the railhead at Mesa. Before the road was finished much hauling was done by burro. Stone out of which the dam facings and partitions were built was quarried from the dam site and spillways. These partitions between the stone facings of the dam were like large rooms into which the cyclopean masses of cement (filled with large stones and boulders) were poured.

Floods Hinder Dam Work

Ironically, the drought ended the year the dam was begun. In 1904, 3,000,000 acre-feet of water went down Salt River. Three times the beginnings of the dam were swept away.

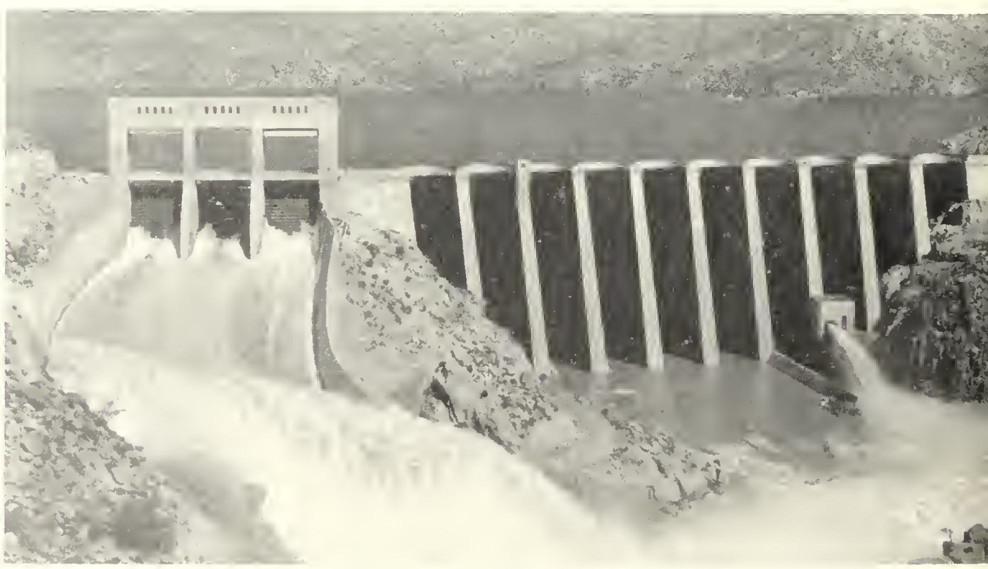
The dam was completed in 1911. Its basin was filled. The canals below were relocated and combined. A permanent diversion dam was built at Granite Reef. The water flowed out upon the thirsty land.

The mere anticipation of water brought people flocking into the Valley. A population of 5,544 in 1900 swelled to 11,134 in 1910, in Phoenix alone.

When the land had been soaked for a few years something began to happen to put fear into people's minds again. The soil of the Valley is estimated to be in some places 500 feet deep, yet in many places there are hard pans, bedrock, which holds the water from seeping down, and an undersurface water table is formed. After a few years of heavy irrigation this land began to waterlog—the same thing that happened to the Hohokam and drove them out. The whites would have had to go, also, had not the same ingenuity that built the dam licked this problem of waterlogging, too. Hydroelectric generating plants were installed at the dam and at drops in the main canals. The resulting power was used for pumping the water out of the ground, the water table was lowered, the river was

First, after Roosevelt Dam brought Salt River water to relieve parched farm lands, came the Mormon Flat Dam.

Then Stewart Mountain Dam, built between 1928–30, completed the conquest of the Salt River.



With Salt River conquered, the farmers fastened the Verde River to their land with the Bartlett Dam. Now the Salt River Valley Water Users' Association could cover every acre of its members' land with a total of 8 feet of water.

put to work to atone for its own sins.

One result of pumping was that it made more water available for irrigation. For every thousand acres irrigated from the reservoir 150 acres could be irrigated from the wells. Thus the benefit of the dam was compounded.

As the population grew, demanding more acreage, the Federal Government financed further developments, and the Salt River Valley Water Users' Association undertook more, with private financing. First after the Roosevelt Dam came the Mormon Flat Dam on Salt River, built between 1924–27. Next the Stewart Mountain Dam on Salt River, built between 1928–30. The conquest of the Salt River was complete.

Clear mountain streams that had formerly gone into the Gila, the Colorado and to the sea, now were held to spin the dynamos and pour docilely into the canals, from which the zanjeros turned them in neatly measured streams through the weirs and into the farmers' ditches. Each year the surf of green beat down another marginal rim of the desert. Finally, in 1936, the farmers turned their eyes to the Verde River and decided to fasten it to the earth with the Bartlett Dam. When this had been done the Salt River Valley Water Users' Association had enough storage capacity for 1,954,000 acre-feet of water. There was enough capacity, when filled, to cover every acre of their land 8 feet deep.

In 1917 the Government turned the project over to the Water Users' Association. Of the total $21,000,000 invested by the Government to June 1941, $12,000,000 has been repaid, and the rest is payable under the Reclamation Act in small long-time installments. The remaining $22,000,000 of capital investment was financed privately. The byproduct of electric power produced at the dams has helped very largely to make payments on these debts, as well as to provide the farmers with economical power for their homes and equipment.

From the Swilling Ditch Co. and a capital investment of $400 worth of tools and equipment and odd coins to the Salt River Valley Water Users' Association is a long way. The Salt River project has five large storage dams, three major diversion dams, 1,400 miles of canals and laterals with over 10,000 structures, 1,850 miles of electric power lines, with 27 large substations, 550 miles of telephone lines, 2 large warehouses, 3 office buildings, over 100 residences, 200 pumping plants. It employs as many as 1,000 people. It has power plants developing 157,000 horsepower and serving 165,000 people in cities and on farms, as well as 3 great copper companies.

Crop Failures Over

Since Roosevelt Dam was built, the Valley has not known a crop failure—and much of any other kind of failure. Here farming, always one of man's worst gambles, has become one of the surest things in the world. Engineers can tell to the fraction of a foot how much water will be available each season, and this surety takes away the guesswork which usually rules the farm. Here they can't afford any guesswork. Farming has become a big business, run with the efficiency methods of big business. It goes on 12 months out of the year, some farms producing three or four crops annually. Where you have only 5 inches of rainfall and 85 percent sunshine through the year, with good growing weather even in mid-winter you can't afford to let the land rest. Neither can you afford to grow the low-price crops like grain, corn, alfalfa. These warm acres turn out trainloads of cantaloupes, cauliflower, carrots, cotton, oranges, grapefruit.

The seed industry promises to be a profitable one, for here—because irrigation is stabilized and water is thoroughly controlled—the seedgrower can be assured of water at the right times and proper germination of his crop, and he has little fear of destructive rains at the wrong time. And the seed gets its full quota of actinic rays, important for fertility.

While farming is the blood and bone of the Salt River Valley it has provided a sound and healthy basis for many other profitable activities. Thousands of head of cattle and sheep are brought into the valley from the higher ranges, to be fed out. Shops and stores are needed to supply the clothes, the furniture, the gadgets, the equipment, the trucks, cars, machinery, fertilizer, insecticides, and cosmetics a prosperous farmer and his wife will buy. And somewhere there must be factories and men to make things. And there must be warehouses, packing plants, sheds, nurseries, creameries, hatcheries, well drillers, tillage contractors.

Thousands of head of cattle are brought into the valley from the higher ranges, to be fed out. This is one of the many agricultural industries for which irrigation water has provided.

Entire floors of downtown Phoenix skyscrapers are occupied by growers, shippers of produce. There must be schools and colleges, newspapers, theaters, hotels, and restaurants. An important business of the city comes from its attraction for tourists and winter residents. There must be hundreds of tradesmen and workmen to keep a city going and growing, for as the farms spread out the city grows. Without irrigation, Phoenix could not have developed as it has.

The farm income in the Salt River project alone doubled from $16,500,000 in 1933 to $35,000,000 in 1943. But Salt River Valley is more than this project. It is the Roosevelt Water Conservation District, with 32,290 acres; the Roosevelt Irrigation District with 29,926 acres; Buckeye Irrigation Co. with 15,500 acres; Maricopa Municipal Water Conservation District (Beardslay) with 27,877; Gillespie Land & Irrigation Co. with 12,857 acres; Southwest Cotton Co. with 19,986 acres; Queen Creek Irrigation District with 9,860, and many others. There are 400,000 acres under cultivation in the Salt River Valley, and still plenty of room to grow.

Looking at this miracle wrought by the alchemy of sun and soil and water and men's minds and hands, Arizonans are not fazed by talk of further stupendous undertakings. To them, miracles have become the commonplace. They would not laugh now at Sam Webb's proposal to bring Colorado River water out into the central valleys of Arizona. In fact they expect it. Not a ditch 7,000 feet deep and 200 miles long, but perhaps a tunnel 175 miles long and miles of great conduits, and a dam bigger than Boulder. They do not call fantastic this talk of water for another half million acres in the Valley of the Sun, Paradise

(Continued on p. 180)

Hearty eaters are the hard working Bentz girls. Seated clockwise around the table from Mr. Bentz are Donna, Phyliss Skau, a visitor; Eunice, Mrs. Bentz, Vera, Virginia, and Ardys.

FORMULA FOR FARM LIVING:

Land + Water + Hard Work

by LYLE M. NELSON*

Today, as Carl Bentz of Fruitland, Idaho, watches the irrigation water finger out through his green alfalfa fields, he can think back to times of rainless skies and withering crops with just a bit of satisfaction. For it wasn't too long ago that the Bentz family, homeless chiefly by virtue of a total crop failure on their dryland farm, took up a homestead on the Black Canyon Division of the Bureau of Reclamation's Boise project.

Land which was then a depressing mass of sagebrush to anyone but a desperate farmer now is growing one of the finest alfalfa crops in the valley. It has been valued to $200 an acre and already has contributed a large tonnage of alfalfa and clover to the Nation's feed supply for beef and dairy herds.

*Bureau of Reclamation, Region 1, Boise, Idaho.

This, then, is a success story. It is the story of how one farmer, knocked down but not out, was given one of the last and least desirable pieces of public land on a Reclamation project and how he made from it a dependable source of living for himself, his wife, and five daughters.

It is a story of independence too. "The Government never gave me one cent of relief money during the depression—I wouldn't have it. But they really set me on my feet when they let me have this farm," Bentz said.

Few farmers in the irrigation-conscious Boise Valley are as enthusiastic about their work as Carl Bentz. All too familiar with drought, heart-breaking labor and total crop failure, Bentz has found the security he desires in the water delivered to him through a Reclamation canal.

"We're sittin' about as nice as we ever have been. This is a beautiful farm," Bentz says, surveying his 75 acres of clover and alfalfa. "Last year we averaged 5 tons of alfalfa to the acre, which is going some."

But the farm wasn't always like that. Bentz and family came to their new home from near Seattle, Wash., where they lost their own farm in the late 30's because June rains, needed for a normal growth of peas, failed to materialize and a $30,000 crop withered in the field.

After renting for several years, Bentz obtained the 160-acre Boise project homestead, bringing with him some furniture and miscellaneous small farm equipment and not much more than the then required minimum of $2,000. Furthermore, he had had no practical irrigation experience. He took up the homestead under provisions of the law which gave preference to farmers who had lost their places through drought or other causes over which they had no control.

Willing to learn from his neighbors and from Bureau land use specialists, Bentz set to work clearing sagebrush from his land. Every member of the family pitched in, working in the field or around the home.

At first Bentz thought the Bureau re-

The Bentz quartet breaks farm work routine.

The mother of the house at work.

Virginia's foot and Vera's pull put a "stubborn-to-start" baler to work.

Virginia hoists 80 pounds of hay.

quirement of at least $2,000 was a bit high. Today he says that it is sound.

"Yes, sir; they know what they're doing. With everything going out the first year or two and practically nothing coming in, it's necessary to have a little cash on hand."

Bentz has definite ideas on how a new farm should be brought in. He believes in taking full advantage of the service provided by the Bureau through its land use staff in cooperation with the State Extension Service. His irrigation system, laid out according to Bureau plan, is a model one. The ditches are scrupulously clean, with just enough grass along the banks to prevent erosion. The heads of all corrugations leading off the distribution ditch are lined with paper and burlap to prevent erosion. The latter are clean cut with practically no washing evident.

Irrigable Acreage Increased

Bentz's turnout and distribution system is patterned after the Bureau's own delivery method. Each of the turnouts from his main ditch is controlled through a box sunk in the bank. The box has a sliding gate by which the amount of water which passes through can be controlled. After passing through the box, the water comes up into a distribution basin from which it filters into the corrugations, thus assuring a steady even flow which can be controlled, particularly important on the Bentz farm because some of the land is quite hilly.

Included in the 160 acres on which Bentz filed were only 59 acres then classified as irrigable land, according to the record books. Most of the rest was considered too steep for irrigation. Actually, through hard work and by controlling his water, Bentz has been able to put 75 acres under cultivation. And what is more, he is growing a good crop of alfalfa and clover on all of it.

Bentz likes to think back to the time when his now green alfalfa fields were being cleared of sagebrush. He worked from dawn to dusk on the fields and often later around the house.

Besides planning an efficient irrigation system with assistance from the Bureau, Bentz believes that one of the most important factors in developing a new farm is to get as much land as possible under cultivation the first year. At the expense of a home or any other needed improvements, he thinks most of the first year's work should go into the land.

"Then you have a little income in the second year and, believe me, that's when you need it," he said. "I'd say that if you're going to do it up right and not on a part time basis, you should put as much land as possible under irrigation the first year."

Bentz does not believe in plowing new land for several years, a point on which he could get considerable argument from other farmers in the locality. Instead, he used a heavy disk to cut out the sagebrush, then went through the land with an ax cutting out remaining brush. After that he disked it thoroughly and planted his alfalfa or clover seed. He believes that such a procedure helps to hold moisture in the ground.

Daughters Earn Schooling

Now that he considers himself well "over the hump" Bentz can look back to the early years with considerable satisfaction. It wasn't easy then to get the farm going and put five daughters through school, particularly when three of them had their minds set on going to college.

But they all worked. Bentz bought a pickup baler and in the summer months the girls formed a baling crew. They did their own work and that of the neighbors, earning tuition for school.

Writing in the *Youth's Instructor*, a church paper, Virginia Bentz describes their experience as follows:

> The end of May had come * * *. Every evidence of a forthcoming good summer was at hand. However, for us * * * vacation time was planned to be a mental vacation only. In order for three of us to be able to attend the academy in the fall, it would be necessary for each one to do her individual part toward earning her own way. * * * We set to work with a will, a high goal before us. We wished to earn enough money to pay all our expenses.
>
> When the time to harvest the first cutting of rich, leafy alfalfa came at last * * * we proceeded to compress the luxuriant forage into uniform bales. * * * All of us learned to do all four of the jobs so that we could trade off every few hours and relieve weary muscles. * * * In this way we set a record of 1,200 bales in 12 hours.
>
> In order to do this it was necessary for us to refrain from wasting one minute of time. We utilized every moment. * * * At last the great day came, and we loaded all our selected paraphernalia into a trailer and were off for nine months of study. We had all earned expenses for those of us who were ready for the academy. Our bill was paid in advance, and we left home—three happy, healthy, sun-tanned girls.

Life Easier Now

And so it was with the Bentz family. Today, the weary hours of baling for neighbors has ended. The Bentz farm is sufficiently developed to confine the girls to baling at home. One is graduating this year from college, two others are working for degrees.

"All of this," says Carl Bentz, "thanks to Reclamation setting me on my feet and some good hard work."

If Bentz has one message for the hundreds of farmers about to establish new homes on Bureau projects, it is this:

"Get yourself a Bureau topographic map for laying out your farm and avail yourself of the advice of Bureau experts; work hard, never quit; get as much land as possible under cultivation the first year."

Giant Generator

The Bureau of Reclamation has issued specifications calling for construction of one of the largest hydro generators ever built—a 108,000-kilowatt giant—to be installed in the right powerhouse at Grand Coulee Dam.

Agreement Sought on Pine Flats Controversy

Driven by a 165,000-horsepower turbine, the world's largest, the generator could turn out in 1 hour more energy than that produced by a locomotive pulling a 100-car freight train at 60 miles an hour from New York to Chicago and back.

Hammering out a "grass roots" policy for payment of charges for water to be supplied from Pine Flats Reservoir, citizens in the Kings River water-service area gathered with Bureau of Reclamation officials and Army representatives at Fresno in the heart of California's central valley July 30.

Funds for construction of Pine Flat Dam were impounded by President Truman until repayment contracts with the water-users have been executed and flood-control and irrigation cost allocations have been agreed upon by the Corps of Engineers and the Bureau of Reclamation.

Located in the Sierra foothills, 30 miles east of Fresno, Pine Flat Dam will tower 338 feet and create a million-acre-foot reservoir to impound Kings River water.

Both supplemental and new water will be supplied to the rich, diversified crop areas of Fresno and Kings counties and the old Tulare Lake basin.

Differences between allocation estimates will be reconciled through a joint reservoir operation study by Bureau of Reclamation, Army, State, and local engineering.

—Courtesy of BIG Magazine.

Culled From Official Files

The Columbia Basin Inter-Agency Committee laid plans at its June meeting for a monthly progress report to include both Federal and State programs. The July meeting has been deferred. The August session will consider the Federal Power Commission study on the distribution of costs of upstream storage to downstream projects.

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The Commissioner of Reclamation and the Chief of Engineers have issued a joint statement concerning the Kings River project in California. They urge local organizations to conclude cost allocations and repayment arrangements under the Reclamation laws as expeditiously as practicable. Construction funds are impounded by direction of the President until such arrangements are made.

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Canadian concurrence is being sought for an international joint investigation of the water resources along the boundary from the continental divide on the west to and including the Red River of the North on the east. It is hoped that the International Joint Commission will make recommendations concerning the division of the waters of the streams in the area not already divided by the treaty of 1909.

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As a result of recommendations formulated in the Water Resources Committee meeting at Omaha, the Interior Missouri Basin Field Committee has been established. The Committee comprises representatives of the Bureau of Reclamation, Geological Survey, Fish and Wildlife Service, National Park Service, Office of Indian Affairs, General Land Office, Grazing Service, and Bureau of Mines.

The committee will meet monthly at least, to consider the scope and adequacy of both the current programs and reports thereon of the several participating Interior Agencies. The committee will coordinate the comprehensive plans prepared by each agency. It also will prepare an annual report to the Secretary of the Interior restating the comprehensive program for the Missouri River Basin.

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The Senate Appropriations Committee and the Senate Military Affairs Committee recently commended the Bureau of Reclamation predevelopment program. The program presented to the Congress during hearings on the Appropriations Bill includes farm-unit surveys: preparation of some public-land homesteads by reimbursable clearing and leveling in places requiring heavy equipment, roughing in of farm distribution systems, and protection where needed to prevent wind or water soil erosion, thereby giving war-veteran settlers an opportunity to harvest a crop during their first year on an irrigation farm; establishment of development and demonstration farms to work out practical adaptations of irrigation methods, soil and crop management to local project conditions: opening of public lands to entry, providing for examination and selection of applicants, assignments of farm-units assistance in layout of farm fields and farm irrigation systems, and advice on irrigation methods and practices in cooperation with State colleges.

Our Front Cover

OUR NEW HOME, DADDY?—*The thoughts and hopes of thousands of ex-servicemen seeking new farm homes in the West are mirrored in the faces of Mr. and Mrs. Don Hafer and son, Alan, as they look over a farm-to-be on a Bureau of Reclamation project near Caldwell, Idaho. Projects under construction or authorized in the Reclamation program will create 100,000 family-sized farms for qualified veterans and others.*

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By an amendment to the Interior Appropriations Bill offered by Senator O'Mahoney, Wyoming, War Relocation Authority centers at Heart Mountain, Hunt, and Tule Lake, and the prisoner-of-war camp at Indianola, Nebr., have been authorized for transfer—complete with all buildings, facilities, and equipment—to the Bureau of Reclamation. A similar transfer was provided for in S-1672, passed by the Senate and in House Committee at time of passage of the appropriations bill.

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Runoff prospects in the Southwest generally remain poor. Carlsbad reservoirs are practically empty and likelihood of improvement in the flow of the Rio Grande and Pecos Rivers is exceptionally poor. Colorado River outlook is poor. Salt River carry-over storage is sufficient for this crop season.

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A subcommittee on Glossary has been formed by the Federal Inter-Agency River Basin Committee to develop standard terms, definitions, and abbreviations.

☆ ☆ ☆

The Mid-Yellowstone Electric Cooperative, Inc., Hysham, Mont., is the first REA co-op to purchase Fort Peck power directly from the Bureau of Reclamation.

☆ ☆ ☆

The Idaho State Reclamation Association recently recommended that reclamation should be combined with flood control and hydroelectric power development wherever feasible.

☆ ☆ ☆

Colorado State College of Agriculture and Mechanical Arts, Fort Collins, Colo., has announced establishment of the Institute of Irrigation Engineering for graduate work leading to a Master of Science degree. Six college departments will participate in the course: Civil Engineering, Agronomy, Geology, History, Mathematics, and Physics. First courses were offered in the summer quarter which began June 24.

Commissioner's Corner

by MICHAEL W. STRAUS, *Commissioner*

Commissioner Straus

This Nation has presented its irrigationists a 12-month program that fairly puts them to the test of their ability to rise to opportunity and perform on the level required in the flashing world of tomorrow.

The Congress provided funds and authority that gives American reclamation a chance to write its record. Whether less than some want, or more than others deem wise, is no longer a matter of debate—the fact remains that the Federal Government on July 1, 1946, made available more money for irrigation in the coming year than ever before in the history of this Nation. Further the Congress clearly said this program will continue—if you can perform in the fashion and on the scope demanded by the economy of today.

The legislative action itself assures no benefits—it is only the prerequisite. The end result of using our limited water and our western arid land to establish citizens on a firm economic base can be achieved only by the reclamationists themselves, be they local, state, or federal, and regardless of whether they be public officials or private citizens.

Our opportunities are unrivaled and our troubles are unprecedented. We are blessed with the advances of engineering science, an unsatisfied demand for land, produce, and power, and a victorious returning army of men able and willing to do the job. We are beset by material and machinery shortages, an unstable and unknown future of costs, wages, and prices, and competition on all sides in a world emerging from the shadow of destruction into the sunlight of reconstruction.

The task laid out for reclamationists will not be done on schedule by bickering and deadlock of local conflict, by unrealistic commitments, by false charge and countercharge, by denunciation and delay or promise without performance. The goal can be reached on time, by resolving differences in a democratic manner and driving on to achieve the benefits which lie ahead for all.

The Bureau of Reclamation, aided by hundreds of public and private groups and thousands of individuals, has evolved a west-wide plan of coordinated and integrated basin-wide development not only for the sixth of the Nation drained by the Missouri River, but also by the Columbia, the Colorado ,the Rio Grande, the San Joaquin, and the Sacramento, as well as the rivers which flow into Great Salt Lake of the Bonneville Basin, and all the valleys of the West. As it unfolds in the coming months—never static, but always improving—its scope and scale will become apparent.

In the first 6 months after the war, construction awards to bring those plans into reality totaled some $4,000,000. In the following 6 months such awards totaled $105,000,000. The velocity has not yet attained the rate fixed for us by the program that has been laid out for reclamationists by the Nation in the coming 12 months.

Ahead lies the test for every irrigationist, engineer, project, district, local, State, and Federal official, for every economist, lawyer, promoter, agriculturist, accountant, planner, builder, ditchrider, manufacturer, and contractor who can make the miracle of reclamation come true. That is the challenge that must be met.

Valley of the Sun

(*Continued from p. 175*)

Valley, and the Yuma District. It is something they are beginning to anticipate and demand as their proper share in the future of the West.

Three projects have been under consideration for the delivery of water and power to the central valleys of Arizona. Any one of them is of a magnitude that would have brought cries of "fantastic!" 20 years ago. But preliminary investigations have shown the three to be feasible. It will take further study of all elements that enter into each proposal,, a careful balancing of advantage against disadvantage before the decision can finally be reached as to which project should be undertaken first. And that decision will be arrived at through cooperation with all groups to be affected.

The most impressive plan, to the layman, is the Marble Gorge plan. Here, 36½ miles below Lee's Ferry a dam larger than Boulder is contemplated. From here water would be taken through a tunnel 135 miles long, with a capacity of 3,000 second-feet or more. Out of this tunnel the water would stream into a series of artificial lakes to be created along the Verde River, and the force of its drop would be turned to power.

Then a canal would carry it to the present Granite Reef Dam, where the last kilowatt of its electrical energy would be extracted before it was turned into the canals and acequias, for use on the land.

The Bridge Canyon plan includes an immense dam at Bridge Canyon, at a point near the upper reach of Lake Mead. A tunnel 72 miles long would carry the water from here to Sacramento Wash, in Mohave County, and from here an 82-mile canal with a capacity of 3,000 second-feet would take the stream to Cunningham Reservoir, which would have a storage capacity of 400,000 acre-feet. Here the surplus would be stored, water for normal needs measured out into a canal of 4,000 second-feet capacity which would carry it 180 miles to Granite Reef Dam.

The Parker Pump plan, while less spectacular, has its advantages, to be weighed against those of the other two. Here a pumping plant would lift water 1,040 feet over the walls of Lake Havasu, and from here a canal would take the water through 32 miles of desert to Cunningham Reservoir, thence to Granite Reef as in the Bridge Canyon plan.

Sunshine, water, deep soil—and vision. These are the four elements out of which prosperous farms and cities and enduring cultures are built. Arizona, rich in land and brilliant sky and canyon-walled rivers, and an air that stimulates the mind to wrestle with the impossible until it becomes the probable, has given the Hohokam and Jack Swilling and Darrel Duppa reasons to look down in amazement at what has happened along the canals they dug with so much labor. And now, with the momentum given by science and new needs, the things that can happen in the next decade or two may yet be as amazing to us who are here as the past 90 years would be astounding to the people who are gone.

Veterans to Sift Homestead Bids

VETERANS of World War II are assured of personal representation on the local examining boards which will apportion the farms to be created from public lands on the Shoshone, Wyo., Klamath, Oreg., and Yakima, Wash., projects this fall. These will be the first public land openings on Reclamation projects since before the war.

Each of the boards has at least one veteran of World War II, and the Klamath board has four veterans among its five members.

The boards are completing the qualifications which will be used as a yardstick to determine successful applicants on each of the projects. Public notices are to be issued within a short time and the boards by September 1 will be deep in the work of actually selecting the applicants.

A thumbnail summary of the personnel of each board follows:

Tule Lake Division, Klamath

(7,527 acres, comprising 86 public land farm units to be allocated)

Nelson Reed, veteran of World War I in which he served as a lieutenant in the company of President (then Captain) Truman; now Klamath agent for a tractor company and member of the Klamath Falls school board; a firm believer in the philosophy of family size farm operations. *Robert Norris*, 22-year-old-veteran of World War II and vice commander of the local American Legion post; now farming 200 acres and intensely interested in providing settlement opportunities for other veterans. *Fred E. McMurphy*, Homesteaded farm on the Klamath project in 1927 which he still owns and operates; past president of the Tule Lake chamber of commerce and past commander of the Tule Lake American Legion post; former appraiser for the Bureau of Reclamation. *Lockie McLeod*, Farmer and active in civic and veterans affairs for 25 years. *E. L. Stephens*, secretary and Bureau of Reclamation representative, project superintendent and connected with the project during most of his adult life.

Heart Mountain, Shoshone

(7,720 acres of public land, comprising 83 farms)

Fred O. Arnold, resident on Shoshone project lands for 21 years and a member of examining board on the old Willwood Division; landowner on Garland Division and seed company manager. *Edgar A. Swallow*, a project resident for 36 years; owner of several farms on Garland Division; retired as farmer several years ago and now vice president of First National Bank of Powell, Wyo., in charge of farm and livestock loans; veteran of World War II with overseas experience. *Lloyd J. Windle*, secretary and Bureau of Reclamation representative, project superintendent.

Roza Division, Yakima

(1,722 acres, comprising 28 public land farms)

Emmett J. McKanna, Jr., 35-year-old-veteran of World War II and insurance and real estate businessman of Yakima; with building and loan company prior to the war. *Cecil C. Clark*, recommended by Roza Irrigation District; farm operator in the Yakima valley most of his life, owner with his wife of 200 acres on the Roza Division and operator of a 45-acre fruit farm under the Union Gap ditch, near Yakima; active in numerous agricultural and community organizations. *D. E. Ball*, secretary and Bureau of Reclamation representative, project superintendent since February 1941, and formerly assistant; connected with the project since 1920; ex-serviceman and active in community affairs.

Former Wave Yeoman Dora Blaser and former Coast Guardsman Wesley Nell, now of the Bureau, tell former Captain Marc E. Forbes and Major John J. Corcoran of Tule Lake lands.

Jack Cline, former submarine service officer, is irrigating 3 acres of Roza grape land.

C. F. Webster, employed jointly by Reclamation and the Extension Service to aid farmers, confers with a veteran, Art Cobel, who has 40 acres in peas on the Roza Division.

This concrete flume was constructed in 1891 by engineers for the Carlsbad Improvement and Development Company to carry water across the Pecos River to the Carlsbad Irrigation project, which was rehabilitated in 1904 by the United States Reclamation Service. Use of underground storage now is seen as a possible means of increasing the irrigation water supply.

LOST: *Irrigation Water*

Quest for Lost Storage May Bring Discovery of More Cabins in Carlsbad, N. Mex., Area

by HAROLD W. MUTCH *

Explorations in the Carlsbad irrigation project area that may lead to discovery of subterranean passages larger than the world-renowned Carlsbad Caverns will be started soon by the Bureau of Reclamation.

The search for possible sub-surface stored water and a dependable storage reservoir site is the result of depleted storage in McMillan Reservoir, one of three supplying water for the Carlsbad project.

Presence of other caves in the vicinity of Carlsbad Caverns and the irrigation project has been known many years, but the extent of these natural wonders remains a mystery. The geological puzzle has become more complicated by the increasing disappearance of water in McMillan Reservoir, 18 miles north of Carlsbad.

It is generally conceded that there may be as much as 50,000 acre-feet of underground storage between McMillan Reservoir and Major Johnson Springs, four miles below McMillan Dam. Dyes have been placed in the reservoir to reappear in the springs three months later. Speculation is rife. Some Bureau specialists believe investigations may lead to the discovery and ultimate use of underground water now stored in huge limestone caverns. The investigations will have no direct connection with the famous Carlsbad Caverns.

Underground storage might be accomplished, say those who speculate in this direction, by controlling flood waters at strategic points in the watershed and directing the flow into the channels of the sub-surface water systems. The regulation and outlets, if not provided by nature in the form of springs and creeks, might be accomplished, they reason, by development of wells and enlarging natural outlets for delivery to irrigation systems.

Alamogordo, McMillan and Avalon Reservoirs store water for the Bureau of Reclamation project in Eddy, DeBaca and Guadalupe Counties. McMillan and Avalon Dams were constructed originally on the Pecos River in 1888 by the Carlsbad Improvement and Development Company.

The coming of the development company to the Pecos River's rich valley lands between the Guadalupe Mountains on the west and the Staked Plains on the east was but another step in the evolution of the West. Irrigation in the area dates back to Spanish settlement in 1600. The irrigation systems of the Spanish people were crude community ditches which diverted the normal flow of the river without benefit of permanent structures.

Engineers for the development company, whose skills and machines for harnessing the Pecos exceeded those of the earlier irrigation farmers, reckoned without sufficient knowledge of, or respect for, the treacherous river. The usually mild stream got its dander up in 1904 and destroyed both McMillan and Avalon Dams.

With 12,000 acres in production, land owners sought the assistance of the Reclamation Service, which had been created in 1902. Subsequent investigations led to rehabilitation of the project. The Reclamation Service, then as now, had definite policies for the development of irrigation projects for family homes to stabilize agriculture and industry and raise the living of people to the highest possible peak.

In the years following rehabilitation and expansion, the Carlsbad project became a show place in the Southwest. It was an oasis in an arid land.

Today, more than 2,000 persons live on the project's 470 farms and suburban homes, where 20,000 acres are in cultivation. The original net construction cost, including McMillan and Avalon

*Mr. Mutch, construction engineer for the Bureau of Reclamation's 45,000-acre irrigation project at Tucumcari, was detailed to the Carlsbad project to conduct preliminary investigations of the Pecos River middle sub-basin.

Dams and the distribution system, totaled $1,144,282. In just one year, 1944, the project's gross crop value amounted to $1,835,986. In 1945, the landowners paid the last instalment on their original debt.

Reclamation engineers who rebuilt McMillan and Avalon Dams more than 40 years ago knew that troublesome years lay ahead. Planning studies revealed geological conditions which greatly limit the opportunities for safe reservoir storage.

The Pecos, with headwaters in the Sangre de Christo Mountains of New Mexico, has a perennial flow supplied by melting snows, and springs. The river travels in a southeasterly direction, leaving the mountainous area near Las Vegas, where the geologic formations change from igneous rocks to sedimentary deposits. Ages ago, intrusive igneous rocks produced an uplifting of the sedimentary formations which allow water to flow down the bedding planes. The river enters Texas 35 miles south of Carlsbad, moving past the storied frontier town of Pecos and joining the Rio Grande in Val Verde County, Texas.

The entire drainage of the Pecos and the peculiar characteristics of precipitation and run-off are favorable to flood stages and heavy silt loads. These factors are of major consequence in the construction and operation of reservoirs on the main stream channels.

Investigations have led some Bureau men to believe that some of the Pecos water sinks from the surface and follows subterranean channels, or aquifers. They believe also that there are two or more channels below the surface channel and that these lower ones follow the general course of the river.

Many formations in the McMillan and Avalon Dam areas are soluble and water, in direct contact with these soluble rocks, flows through tiny cracks and crevices which expand and become channels and passage ways.

Bureau of Reclamation explorers soon may learn whether this subterranean passage, five miles below McMillan Dam in New Mexico, leads into others as large as the famous Carlsbad Caverns. This cavern is typical of solution channels in the Carlsbad irrigation project area which present major storage problems.

Attempting to overcome this problem, engineers for the old United States Reclamation Service constructed dikes along the sides of McMillan Reservoir which were designed to hold water away from the largest leaks, but the dikes were not successful, and water losses continued.

Salt cedars first appeared in the McMillan Reservoir area in 1917. At first these thirsty beggars were considered a blessing because they retarded silt deposition in the lake. However, in the years following, the river channel began filling and also became infested with cedars. The stream gradient flattened upstream above the reservoir. It is estimated that the salt cedars consume 50,000 acre-feet of water annually, which is about half the normal need of the Carlsbad project.

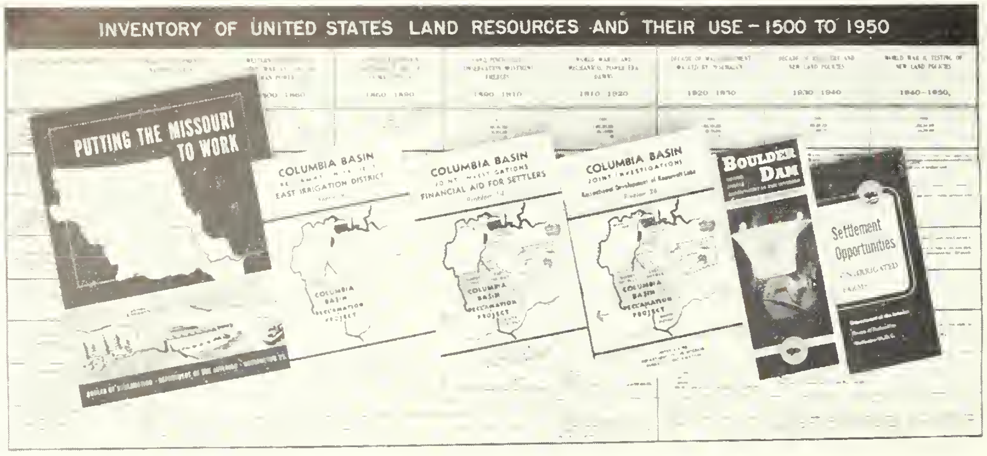
A Navy amphibious tank invades a jungle of salt cedars, McMillan Reservoir area, Carlsbad Irrigation project, New Mexico. These salt cedars consume 50,000 acre-feet of water annually, about half the normal need of the Carlsbad project.

The shrinking storage capacities of McMillan and Avalon Reservoirs had become so acute by 1936 that the Carlsbad Irrigation District entered into a contract with the Bureau of Reclamation for the construction of Alamogordo Dam on the Pecos, 15 miles from Fort Sumner and approximately 200 miles upstream from the project. Alamogordo Dam was designed to release stored water to the Carlsbad project and equalize the depleted storage in McMillan and Avalon Reservoirs.

Subsequent to completion of Alamogordo Dam in 1937, nature cut another caper in the area. Prolonged droughts in the watershed created critical water shortages in 1945 and 1946. Even in years of abundant storage in Alamogordo Reservoir, the 200-mile flow of the Pecos from the dam to the project takes its toll of valuable water and this loss is augmented by diversions and underground water developments along the river above Carlsbad.

Some project farmers are drilling wells to supply their farms to tide them over the crisis. Meanwhile, Bureau specialists are speeding their investigations to find safe storage sites near the farms. These efforts are continuing while other Bureau personnel hope they can conduct further explorations of underground storage this summer while the river flow is low.

The results of subterranean explorations may lead to a series of weird engineering accomplishments which will exceed the peak performances of Ali Baba and the Forty Thieves, who also used a cave for storage. Time will tell.



RECLAMATION'S BOOKSHELF

Recent Bureau Publications

1. *Inventory of United States Land Resources and Their Use—1500 to 1950.*—A chart for wall display and study. To be obtainable soon from the Superintendent of Documents, Washington, D. C.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the East Columbia Basin Irrigation District—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy from the Superintendent of Documents, Washington, D. C.

4. *Maps of Seven States Showing Water Resources Development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C.

5. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy from the Superintendent of Documents, Washington, D. C.

6. *Approved Missouri River Plan Map.*—Color map showing reservoir and dam sites in the basinwide construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

7. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to your Regional Director.

8. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ending June 30, 1945). Obtainable on request to the Bureau of Reclamation as directed above.

9. *Boulder Dam.*—Illustrated folder on the world's highest dam. Obtainable on request to the Bureau of Reclamation at Washington or Boulder City, Nev.

Miscellaneous Publications

"Missouri River Basin Development" by Lt. Col. Delbert B. Freeman, Corps of Engineers, U. S. Army, District Engineers, Omaha, Nebr., in *Civil Engineering*, June 1946, page 259. A comprehensive discussion of the problem of control in the Missouri River Valley, which includes every condition from drought to flood.

"Water Use Projects Move to Active Stages As Congress Provides Money," in *Engineering News-Record*, May 23, 1946, page 10. Major developments in irrigation and navigation work approach construction stage as engineers approve plans.

Water and Our Forests by Bernard Frank and Clifford A. Betts, March 1946. Miscellaneous Publication No. 600. Forest Service, U. S. Department of Agriculture. 29 pages with illustrations. "Water, like air, is accepted by man as a matter of course, and he seldom stops to think that without it life would be utterly impossible. Only in times of drought or flood does he appreciate its true significance. Then he realizes that if it is to become a willing servant, he must learn to understand and control its behavior from the time it reaches the earth until it empties into the sea." (Lyle F. Watts, chief, Forest Service, in the foreword).

Motion Pictures

The Bureau of Reclamation distributes 16 mm. motion pictures relating to its activities. The films will be loaned the borrower willing to pay the express charges both ways. The list follows:

(Distributed from the Bureau of Reclamation Office, Washington, D. C.)

Boulder Dam	5 reels (silent)
Boulder Dam	4 reels (sound)
Reclamation in the Arid West	1 reel (sound)
Fundamentals of Irrigation	3 reels (sound)
Irrigated Pastures (Kodachrome)	2 reels (sound)
Fighting Weeds (Kodachrome)	3 reels (sound)
Measurement of Water (Kodachrome)	3 reels (sound)

For Your Art Collection

Write to the Bureau of Reclamation, Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue. In ordering, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States.

CONTACT PRINTS (single weight glossy paper), available only if size of negative permits.

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5 x 7	.20
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8 x 10 single weight glossy	.60
11 x 14 single weight glossy	1.25
11 x 14 double weight mat	1.50
16 x 20 double weight mat	2.50
20 x 24 double weight mat	3.00
24 x 30 double weight mat	5.00
24 x 36 double weight mat	6.00
30 x 40 double weight mat	8.00
	Per sq. ft.
Over 30 x 40 double weight mat	.85

Recent Project Maps

Published by the Bureau of Reclamation

Western Half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 x 20 inches. FREE.

Orland Project, California. Map No. 45–45, (supersedes No. 21880). Blue, green, and black. Size 8 x 10½ inches, price 10 cents.

Grand Valley project, Colorado, Map No. 45–40, (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 x 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52, (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 x 20 inches, price 25 cents.

Note.—In ordering maps, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States and address your order to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

Notes to Contractors

Construction and Supply Contracts Awarded During Month of June

Specification No.	Project, division, and State	Date contract awarded	Description of work or material	Contractor's name and address	Contract amount
1280	Davis Dam—Arizona	June 3	Materials for steel warehouse building	American Bridge Co., Denver, Colo.	$39,024.00
1284	Riverton—Pilot division—Wyoming	June 3	Earthwork, structures, lost wells lateral system	Sharrock and Pursel, Casper, Wyo.	185,560.00
1295	Columbia Basin—Washington	June 3	150-ton gantry crane structure, Grand Coulee Dam	Star Iron and Steel Co., Tacoma, Wash.	49,900.00
1217	Shoshone and Kendrick—Wyoming	June 4	Carrier-current telephone terminal equipment, Casper substation, Shoshone power plant, and Thermopolis substation.	Huber Radio Co., Casper, Wyo., Schedule 2.	6,151.00
1194	Boise—Idaho	June 6	Coustruction of Cascade Dam and completion of earthwork, structures, track, and telegraph line, relocation of Idaho branch, Oregon Short Line Railroad.	Morrison-Knudsen Co., Boise, Idaho	1,396,889.00
1181	Central Valley—Friant division—California.	June 6	Earthwork, canal lining, structurers, Kings River wasteway, Friant-Kern Canal, station 1591+66 to station 1647+75.	Morrison-Knudsen Co. and M. H. Hasler, Los Angeles, Calif.	1,514,975.45
1204	do	June 6	Schedule 2, earthwork, concrete lining, structures, Friant-Kern Canal, station 1932+75 to station 2631+00.	do	1,829,457.45
1204	do	June 6	Schedules 1, 3, and 4, earthwork, concrete lining, structures, Friant-Kern Canal, station 1647+75 to station 1932+75 and station 2631+00 to station 3875+00.	Arizona-Nevada Constructors, Phoenix, Ariz.	5,079,976.25
1277	Shoshone—Wyoming	June 7	Circuit breaker, lightning arresters, switches, current transformers, demand meters, Heart Mountain construction substation.	Westinghouse Electric Corp., Denver, Colo.	3,624.37
1282	Boise—Idaho	June 10	Structural steel roof framing, Anderson Ranch power plant.	American Bridge Co., Denver, Colo.	11,205.00
1232	Yakima-Roza—Washington	June 11	Earthwork, structures, wasteway No. 5 extension, station 162+78 to station 539+00.	Fiorito Bros., Seattle, Wash.	460,534.50
1266	Columbia Basin—Washington	June 12	1-150,000 gal., 1-300,000 gal., and 1-60,000 gal. welded-steel water storage tanks, water supply system, Grand Coulee power plant.	American Pipe and Steel Corp., Alhambra, Calif.	17,082.00
1229	Central Valley—Delta division—California.	June 12	2 Pumping units, Ygnacio Canal pumping plant; 3 units, Clayton Canal pumping plant.	Allis-Chalmers Mfg. Co., Milwaukee, Wis	16,136.00
1314	Missouri Basin—Boysen unit—Wyoming.	June 12	Construction warehouse building, Boysen Government Camp.	Charles M. Smith, Thermopolis, Wyo.	35,407.50
1276	Buffalo Rapid—Montana	June 13	Pumping unit, Fallon pumping plant; erecting engineer if required.	Fairbanks Morse & Co., Kansas City, Mo.	6,646.00
1184	Shoshone—Wyoming	June 13	Schedule 2, 30,000 foot-pound capacity governor	Woodward Governor Co., Rockford, Ill	16,118.00
1236	Columbia Basin—Washington	June 13	Schedules 1 and 3, earthwork, canal lining, structures, Main Canal, station 24+00 to station 93+00 and station 214+00 to station 430+00.	J. A. Terteling & Sons, Inc, Boise, Idaho.	1,548,060.00
1236	do	June 13	Schedule 2, earthwork, canal lining, structures, Main Canal, station 93+00 to station 214+00 (Bacon siphon and tunnel).	T. E. Connolly, Inc., San Francisco, Calif.	3,494,420.00
1183	Central Valley—Delta division—California.	June 14	Earthwork, concrete lining, structures, Delta—Mendota canal, station 686+00 to station 1365+00 and Westley wasteway.	Hubert H. Everist, Sr., San Francisco, Calif.	3,530,067.50
1225	Boise—Idaho	June 18	5-72″ ring-follower gates with hoists, gate hangers, Anderson Ranch Dam.	Goslin-Birmingham Mfg. Co., Birmingham, Ala.	112,000.00
1273	Columbia Basin—Washington	June 18	Steel work barge, 3 drum hoists and controls for maintenance of spillway bucket, Grand Coulee Dam.	American Bridge Co. Denver, Colo.	59,061.00
1291	do	June 18	1,188 trashracks for main units, right power house, Grand Coulee Dam.	Joshua Hendy Iron Works, San Francisco, Calif.	286,300.00
1275	Colorado-Big Thompson—Colorado	June 18	Schedules 1 and 2, Horsetooth Dam and Satanka dike; Soldier Canyon Dam. (Horsetooth reservoir.)	Grafe-Callahan Construction Co., Gunther & Shirley Co., W. K. McIlyor, Los Angeles, Calif.	5,111,877.00
1275	do	June 18	Schedules 3 and 4, Dixon Canyon Dam; Spring Canyon Dam; Horsetooth Reservoir.	Hinman Bros. Construction Co. and Rhoades Bros. & Shofner, Denver, Colo. and Los Angeles, Calif.	4,319,427.00
1231	Columbia Basin—Washington	June 18	Construction South Coulee Dam	Ray L. Blair & Co. and James Crick & Sons, Spokane, Wash.	2,771,887.50
1218	Rio Grande—New Mexico	June 19	Schedule 2, Coupling Capacitors, Elephant Butte power plant, Las Cruces substation; carrier line traps, Elephant Butte power plant, tap line to White Sands substation, Alamogordo Air Base.	Westinghouse Electric Corp., Denver, Colo.	6,593.75
1186	Balmorhea—Texas	June 19	Earthwork, Canal lining, structures, Phantom Lake canal, Inlet Feeder canal to Lower Parks reservoir.	H. B. Zachry Co., San Antonio, Tex	168,646.60
1220	Central Valley—Kennett division—California.	June 19	Furnishing and installing 3 drum gates for spillway, Shasta Dam.	American Bridge Co., Denver, Colo.	492,449.00
1233	Columbia Basin—Washington	June 20	60″ plate-steel pump discharge pipe, Pasco pumping plant	Pacific Coast Engineering Co., Alameda, Calif.	46,000.00
1253	Central Valley—Kennett division—California.	June 21	14 outlet gates with hoists, motor reducer units, indicators for river outlets, Shasta Dam.	Joshua Hendy Iron Works, San Francisco, Calif.	512,500.00

Construction and Supply Contracts Awarded During Month of June—Continued

Specification No.	Project, division, and State	Date contract awarded	Description of work or material	Contractor's name and address	Contract amount
1241	Central Valley—Delta division—California.	June 21	Construction of Ygnacio and Clayton pumping plants, Contra Costa Canal system.	Walsh & Puccetti, Walnut Creek, Calif.	$55,233.10
1310	Columbia Basin—Washington	June 24	Materials except concrete floor and foundations for 5 puller houses.	Gardiner Mfg. Co., San Francisco, Calif.	12,694.35
1184	Shoshone—Wyoming	June 25	Schedule 1, 8,300-hp, 450 rpm turbine, Heart Mt. power plant.	S. Morgan Smith Co., York, Pa.	58,750.00
1184	do	June 25	Schedule 3, 6,000 kva, 2,400 volt generator	Elliott Co., Ridgway, Pa.	59,377.00
1289	Columbia Basin—Washington	June 25	Drilling Moses Lake water supply well (schedule 2)	Hosack & Son, Nampa, Idaho	17,538.75
1318	do	June 27	Construction Pasco pumping plant	James Construction Co., Seattle, Wash.	188,537.68
1321	Yakima-Roza—Washington	June 27	Construction pumping plants for areas Nos. 5, 6, 7, 9, 9A, 10, 12, 17.	John Klug & Co., Yakima, Wash.	127,021.90
1297	Palisades—Idaho	June 28	40 two-bedroom prefabricated houses, Palisades Government Camp.	Green Lumber Co., Laurel, Miss.	90,000.00
1230	Columbia Basin—Washington	June 28	Earth, lateral lining, pipe lines, structures, Pasco pump lateral, sublaterals, waste water ditches.	J. A. Terteling & Sons, Boise, Idaho	714,223.00
1326	Hungry Horse—Montana	June 28	Construction warehouse building, Hungry Horse Government camp.	Dudley Construction Co., Great Falls, Mont.	91,288.00
1192	Central Valley—Delta division—California.	June 28	6 centrifugal pumps, Delta Mendota pumping plant	Worthington Pump & Machinery Corp., Denver, Colo.	696,721.00
1225	Columbia Basin—Washington	June 28	Furnishing & installing electric elevator, block 64, Grand Coulee Dam.	Otis Elevator Co., San Francisco, Calif.	167,437.00
1267	Central Valley—Kennett division—California	June 28	Furnishing & installing electric elevator, Shasta Dam	Westinghouse Electric Corp., Jersey City, N. J.	76,425.00
1286	Columbia Basin—Washington	June 28	Earthwork, canal lining, structures, sta. 2+50 to 350+00 West Canal.	Utah Construction Co. and Winston Bros. Co., San Francisco, Calif.	2,871,769.50
1317	Central Valley—Kennett division—California.	June 28	Jet pump for fish trap, Keswick Dam	Pacific Coast Engineering Co., Alameda, Calif.	26,800.00
1320	Missouri Basin—Boysen unit—Wyoming	June 28	Government Camp streets, walks, curbs, gutters; drainage, sewerage and water-distribution systems.	Charles M. Smith, Thermopolis, Wyo.	112,382.00
1329	Yakima Roza—Washington	June 28	Earthwork, pipe lines, concrete lining, structures, lateral distribution systems, Pump areas Nos. 3 and 4.	The Shoshone Co., Twin Falls, Idaho	104,248.14

Construction and Supplies for Which Invitations for Bids Will Be Requested During August

Estimated date bids to be invited	Estimated bid opening date	Project	Description of work or material
Aug. 1	Sept. 5	Colorado Big Thompson—Colorado	2-4500 g. p. m. deep well, turbine-type unwatering pumps and 2-800 g. p. m. deep well, turbine-type drainage pumps, Granby pumping plant.
Aug. 1	Sept. 5	Davis Dam—Arizona	2-500 c. f. m. horizontal, two-stage air compressors and 1-100 c. f. m. horizontal single-stage air compressor; complete with after coolers and receivers.
Aug. 3	Sept. 8	Boise—Payette division—Idaho	Materials for construction of C-Line canal pumping plant.
Aug. 3	Sept. 8	Missouri Basin—Heart River unit—North Dakota	Construction of housing, misc. buildings and utilities for Government Camp.
Aug. 5	Sept. 8	Central Valley—Delta division—California	Reinforcement bars—Delta-Mendota Canal station 686+00 to station 1365+00.
Aug. 7	Sept. 10	Missouri Basin—Lower Marias unit—Montana	Construction of Tiber Dam (earthfill). (Previously estimated for July advertisement).
Aug. 10	Sept. 15	Missouri Basin—Yellowstone River pumping unit—Montana-North Dakota.	Pumping units for Savage pumping plant. (Previously estimated for June advertisement).
Aug. 10	Sept. 15	Yakima-Roza—Washington	Pumping plant discharge lines, pumping areas Nos. 1 to 17.
Aug. 12	Sept. 17	Riverton—Pilot division—Wyoming	Reinforcement bars, Lost Wells lateral system.
Aug. 12	Sept. 17	do	Lumber, Lost Wells lateral system.
Aug. 15	Sept. 19	Altus—Oklahoma	Raising highway No. 9 bridges and approaches.
Aug. 15	Sept. 19	Boulder Canyon—Nevada	Metal partitions and railings, Boulder power plant.
Aug. 15	Sept. 19	Central Valley—Kennett division—California	Station service transformers and power cabinets, Keswick switchyard.
Aug. 15	Sept. 19	Colorado-Big Thompson—Colorado	Elevator, Granby pumping plant.
Aug. 15	Sept. 19	do	Elevator, Granby Dam.
Aug. 15	Sept. 19	Columbia Basin—Washington	2-1200 g. p. h. oil purifiers for right powerhouse and switchyards, Grand Coulee.
Aug. 15	Sept. 19	do	Power and control cable for units L7, L8, L9, Grand Coulee power plant.
Aug. 15	Sept. 19	do	Earthwork, canal lining, tunnel and structures, Potholes E. Canal, station 24+39 to station 436+00.
Aug. 15	Sept. 19	Mancos—Colorado	High pressure gate (2′9″ x 2′9″) Jackson Gulch Dam.
Aug. 15	Sept. 19	Missouri Basin—Frenchman-Cambridge unit—Nebraska	High pressure gate (6′0″ x 7′6″) Enders Dam.
Aug. 15	Sept. 19	Missouri Basin—Missouri River pumping unit—Montana-North Dakota.	Pumping units for Square Butte pumping plant (previously reported for June 1946).
Aug. 15	Sept. 19	do	Pumping units for Wogansport pumping plant (previously reported for June 1946).
Aug. 15	Sept. 19	do	Construction of pumping plants and appurtenant structures, Wogansport unit.
Aug. 15	Sept. 19	Missouri Basin—Yellowstone River pumping unit—Montana.	Earthwork and structures, Savage unit main canal and laterals.
Aug. 20	Sept. 24	Boulder Canyon—Nevada	Surge suppressors, valves, and manifolds, Boulder City supplemental water supply.
Aug. 21	Sept. 25	Central Valley—Kennett division—California	Construction of roads and parking areas, Shasta Dam.
Aug. 23	Sept. 29	Parker Dam power—Arizona	Galvanized structural steel switchyard structures, Gila substation.
Aug. 25	Sept. 29	Missouri Basin—Kirwin unit—Kansas	Construction Kirwin Dam (earthfill), railroad and highway relocation. (Previously estimated for June advertisement).
Aug. 25	Sept. 29	Davis Dam—Arizona	Main control board, Tucson substation.
Aug. 28	Oct. 2	Tucumcari—New Mexico	Earthwork and structures, Conchas canal, station 2662+00 to station 4452+46 and laterals in unit No. 6.
Aug. 28	Oct. 2	Columbia Basin—Washington	Reinforcement bars, main canal station 24+00 to station 430+00.
Aug. 30	Oct. 5	Boise—Anderson Ranch—Idaho	Generator protective equipment for Anderson Ranch power plant.
Aug. 30	Oct. 5	Boise—Payette division—Idaho	12′ x 13.38′ fixed wheel gate, Cascade Dam.
Aug. 30	Oct. 5	do	5′ x 5′ high pressure gates, Cascade Dam.
Aug. 30	Oct. 5	Boulder Canyon—All-American Canal—California	Radial gate and hoist for White Water siphon, check and wasteway.
Aug. 30	Oct. 5	Buffalo Rapids—Second division—Montana	Power transformers and substation equipment. Fallon Pump and Relift pumping plants.
Aug. 30	Oct. 5	Central Valley—Delta division—California	5 radial gates and hoists, Delta-Mendota Canal.
Aug. 30	Oct. 5	Colorado-Big Thompson—Colorado	High pressure gates (5′ x 5′), Horsetooth Reservoir.
Aug. 30	Oct. 5	do	High pressure gates (6′ x 7′6″), Estes Park power plant.
Aug. 30	Oct. 5	do	Turbines, governors, and generators, Estes Park power plant.
Aug. 30	Oct. 5	do	Turbines, governors, and generators, Marys Lake power plant.
Aug. 30	Oct. 5	do	Granby pumping plant motors and controls.
Aug. 30	Oct. 5	Columbia Basin—Washington	3 elevators, Grand Coulee pumping plant.
Aug. 30	Oct. 5	do	High pressure gate, (4′ x 4′) Potholes Dam.
Aug. 30	Oct. 5	do	High pressure gate (4′ x 4′), Long Lake Dam.
Aug. 30	Oct. 5	Missouri Basin—Angostura unit—South Dakota	High pressure gate (3′6″ x 3′6″), Angostura Dam.
Aug. 30	Oct. 5	Missouri Basin—Canyon Ferry unit—Montana	Generators, Canyon Ferry power plant.
Aug. 30	Oct. 5	Missouri Basin—Heart River unit—North Dakota	High pressure gates (4′ x 4′ and 2′9″ x 2′9″), Heart Butte Dam
Aug. 30	Oct. 5	Missouri Basin—Missouri River pumping unit—North Dakota.	Motor controls and equipment, Wogansport pumping unit.
Aug. 30	Oct. 5	Missouri Basin—Yellowstone River pumping unit—Montana.	Power transformers and substation equipment, Savage pumping plant.
Aug. 30	Oct. 5	Palisades—Idaho	Government Camp buildings.
Aug. 30	Oct. 5	Parker Dam power—Arizona	Material for structural steel machine shop building.
Aug. 30	Oct. 5	Shoshone—Heart Mountain—Wyoming	Materials for coustruction of Heart Mountain power plant.
Aug. 30	Oct. 5	Yakima Roza—Washington	Miscellaneous equipment for Roza division pumping units.
Aug. 30	Oct. 5	Buffalo Rapids—Second division—Montana	Motor control equipment for third unit, Fallon pumping plant.

World's Largest Pumping Plant Going Up at Grand Coulee

The jackhammers are chattering again at Grand Coulee Dam.

Behind the 600-foot "wing" dam at the west end of the world's largest concrete structure, helmeted Government employees have resumed work on what will be the world's largest pumping plant. And on the slopes of the granite mountain above them, fellow workmen are drilling, blasting, and excavating for the giant feeder canal which will start Columbia River water flowing downhill to the million sunbaked acres in the Columbia Basin project.

Although a substantial beginning on the pumping plant was made before Lake Franklin D. Roosevelt was created behind Grand Coulee Dam, a great deal remains to be done before water will run uphill into the equalizing reservoir which will be formed in the Grand Coulee.

The "wing" dam, base for the pumping plant, was built at the same time as the main dam. Similar in design to the main structure, it has trashracks, intake structures, and pump-intake pipes in place. The tunnels which will carry the outlet pipes from the pumps up the hill to the headworks of the feeder canal also were completed before final grouting of concrete and bedrock for the "wing" dam was done. The tunnels, from 487 to 530 feet in length, are 23 feet in diameter at their lower ends and taper to 18½ feet.

Bids were called in May for approximately 9,600 feet of steel pipe to carry water through the tunnels. The pipes will be 12 feet in diameter, and in 20- to 31-foot sections. Joints will be welded, and inspected by X-ray. Space between the tubes and the rock wall in the tunnels will be filled with concrete and reinforcing steel. After emerging from the tunnels, the pipes will continue on concrete piers for about 260 feet to the feeder canal headworks.

The pipes will terminate in siphon elbows with their discharge ends submerged in the headworks. Each siphon elbow will be provided with a solenoid-operated air valve which will open when the pump is stopped and will admit air to break the vacuum, thus preventing reversal of flow through the siphon.

The concrete-lined feeder canal, which also will be constructed by Government forces, will be 1.6 miles long. Its capacity will be 16,000 second-feet, the equivalent flow of several ordinary-size rivers. The equalizing reservoir, into which the feeder canal will empty, will be 27 miles long, with an active capacity of 700,000 acre-feet. The reservoir will be formed by two huge earth-and-rock dams, one near the village of Grand Coulee, and the other near Coulee City.

The lower ends of the pipes will connect directly to the world's most powerful pumps. Each will have 8 times the capacity of the largest pumps in use today. Twelve of the pumps, each capable of serving 100,000 acres, eventually will be installed in the pumping plant. Two will be held in reserve. The 10 which will be used regularly when the irrigation system is complete will be capable of lifting 1,000,000 pounds of water 270 feet per second—the equivalent of pushing 500 tons of water to the top of a 27-story building every second.

The pumps are expected to operate under a 270-foot head about 70 percent of the time. Engineers estimate that the maximum head under which the units will operate will be 365 feet, a condition which will occur only 3 percent of the time. Specifications call for each pump to deliver not less than 1,350 cubic feet of water per second when operating at 200 revolutions per minute under a total dynamic pumping head of 310 feet, and to deliver approximately 1,600 and 900 cubic feet per second under total dynamic pumping heads of 270 and 365 feet, respectively.

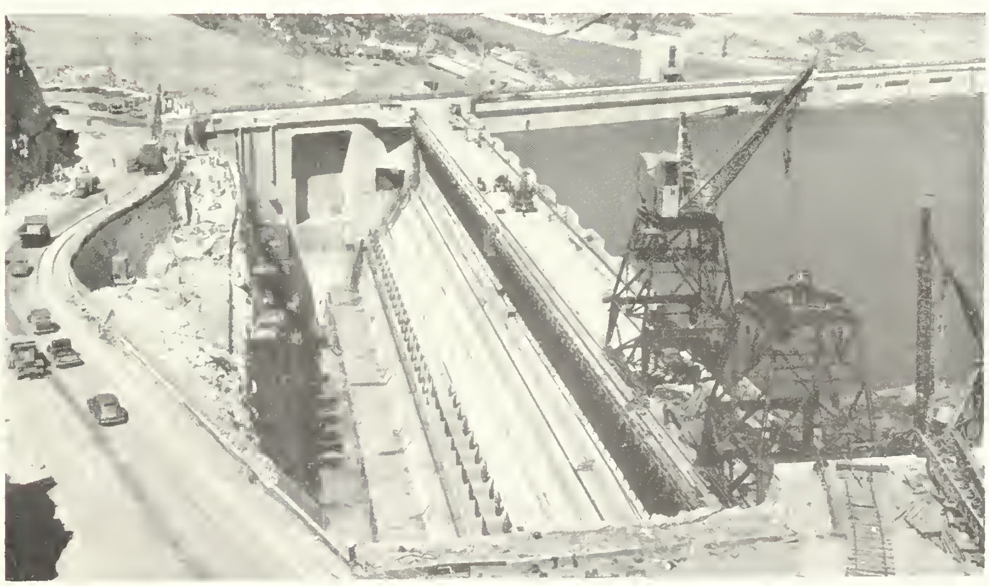
The pumps are to be of the vertical-shaft, single suction, centrifugal type. Each impeller is to be cast in one piece, of cast steel or manganese bronze, to be machine-finished on all external surfaces, and to be accurately finished to templates internally. Shafts are to be of "forged carbon or alloy steel suitably heat-treated." Pump casings may be made of cast steel sections or plate steel, but must limit unbalanced hydraulic aside thrust to 100,000 pounds.

The Byron Jackson Co. of Los Angeles and the Pelton Water Wheel Co., San Francisco, equal associates, recently were awarded a $1,062,975 contract for 6 pumps which are to be installed in connection with the Bureau of Reclamation's initial goal of 100,000 irrigated acres by 1951.

Under the bid announcement, the first of the pumps must be delivered within 600 calendar days after the contractor is officially notified to proceed with their manufacture, and the others at 60-day intervals thereafter. Tentative plans call for their installation in 1948–49.

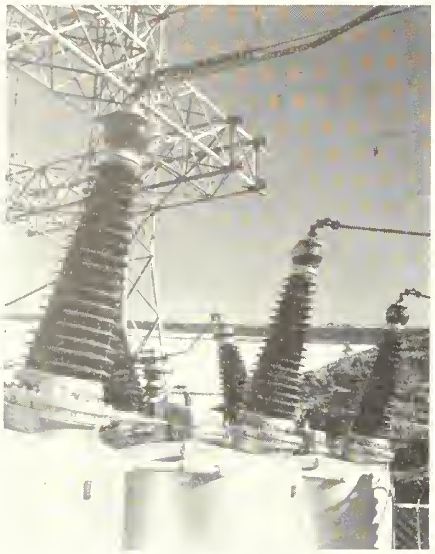
The pumps will be driven by the world's strongest electric motors. These will be 65,000-horsepower, direct-connected, 13,800-volt, synchronous motors, to run 200 revolutions per minute. Each pair of motors will be powered by one of the

(Continued on p. 188)



Construction has been resumed at Grand Coulee Dam on the pumping plant (foreground) for the immense Columbia Basin project. This view shows completed whirley crane, a companion crane under construction, diamond drilling, and doweling of the rock backwall. The "wing" dam forms the base of the pumping plant.

Our Back Cover



ROBOT WATCHMEN—These mammoth insulator bushings of the giant oil circuit breakers at Shasta Dam are part of the mechanism for guarding the entire power load. They prevent the 75,000-kilowatt generators from burning out. Shasta's generators are playing an important role in reconversion by providing power for peacetime industries.

World's Largest Pumping Plant

(*Continued from p. 187*)

mighty 108,000-kilowatt generators at Grand Coulee Dam. Under adverse conditions, a generator may be able to operate only one pump. The motors will be located directly over the pumps, and each motor-pump installation will be approximately 50 feet high. Bids on the motors will be opened in Denver August 16.

On the basis of 1940 prices, the completed pumping plant is estimated to cost approximately $31,000,000.

The present phase of construction on the pumping plant began last December with diamond drilling of the first of forty-five 6-inch dowel holes in the rock back wall to reinforce a slip seam. The dowels were fabricated from ten 1¼-inch reinforcing steel bars, spotwelded around one-half-inch grout pipe. Grouting in of the dowels was completed in April, but grouting of the seams remains to be done.

Along the top of the rock back wall of the pumping plant, excavation is under way for a concrete retaining wall which will support the outer edge of a new four-lane highway. And a deeper cut is being made into the rock cliff above the back wall for this highway which will replace the present main-traveled road into Coulee Dam.

Installation of gantry crane rails and bridging across the pumping plant gate chambers was completed recently, and two 45-ton revolving cranes are now in service.

Former serviceman Joe Herman, Bureau transitman, checks calculations on the Granby Dam site as contractors move in their heavy equipment and lay out workers' quarters. The dam will be one of the key features of the Colorado-Big Thompson project.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users—Continued

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Lower Yellowstone	Board of control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont.	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont.	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho.
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	do	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev.	Philip Hibel	Superintendent.	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr.	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr.	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr.	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington, Wyo.	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr.	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	Arlie S. Campbell	do	William T. Davis	Brigham City, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash.	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo.	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz.	H. J. Lawson	Superintendent.	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo.	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo.	Floyd Lucas	do	E. F. Andrews	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg.	Leo F. Clark	do	F. A. Baker	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont.	A. R. Hansen	Manager	A. R. Hansen	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont.	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev.	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg.	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo.	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg.	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash.	G. L. Sterling	do	G. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash.	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1946 702884

Personnel and Project Directory

J. A. KRUG, SECRETARY OF THE INTERIOR

Commissioner's Office

Michael W. Straus, Commissioner — **Kenneth Markwell, Assistant Commissioner** — **William E. Warne, Assistant Commissioner**

Clifford E. Fix, Chief Counsel; T. W. Mermel, Acting Assistant to the Commissioner—Engineering; G. S. Ellsworth, Assistant to the Commissioner—Management; Barrow Lyons, Chief Information Officer; William F. Kubach, Director of Finance; Glenn D. Thompson, Chief Personnel Officer; Kenneth F. Vernon, Progress Control Officer; C. A. D. Young, Director of Supply

Branch Directors

John W. Dixon, Director, Branch of Project Planning; Walker R. Young, Chief Engineer and Director, Branch of Design and Construction (Denver); Harvey F. McPhail, Director, Branch of Power Utilization; Goodrich W. Lineweaver, Director, Branch of Operation and Maintenance

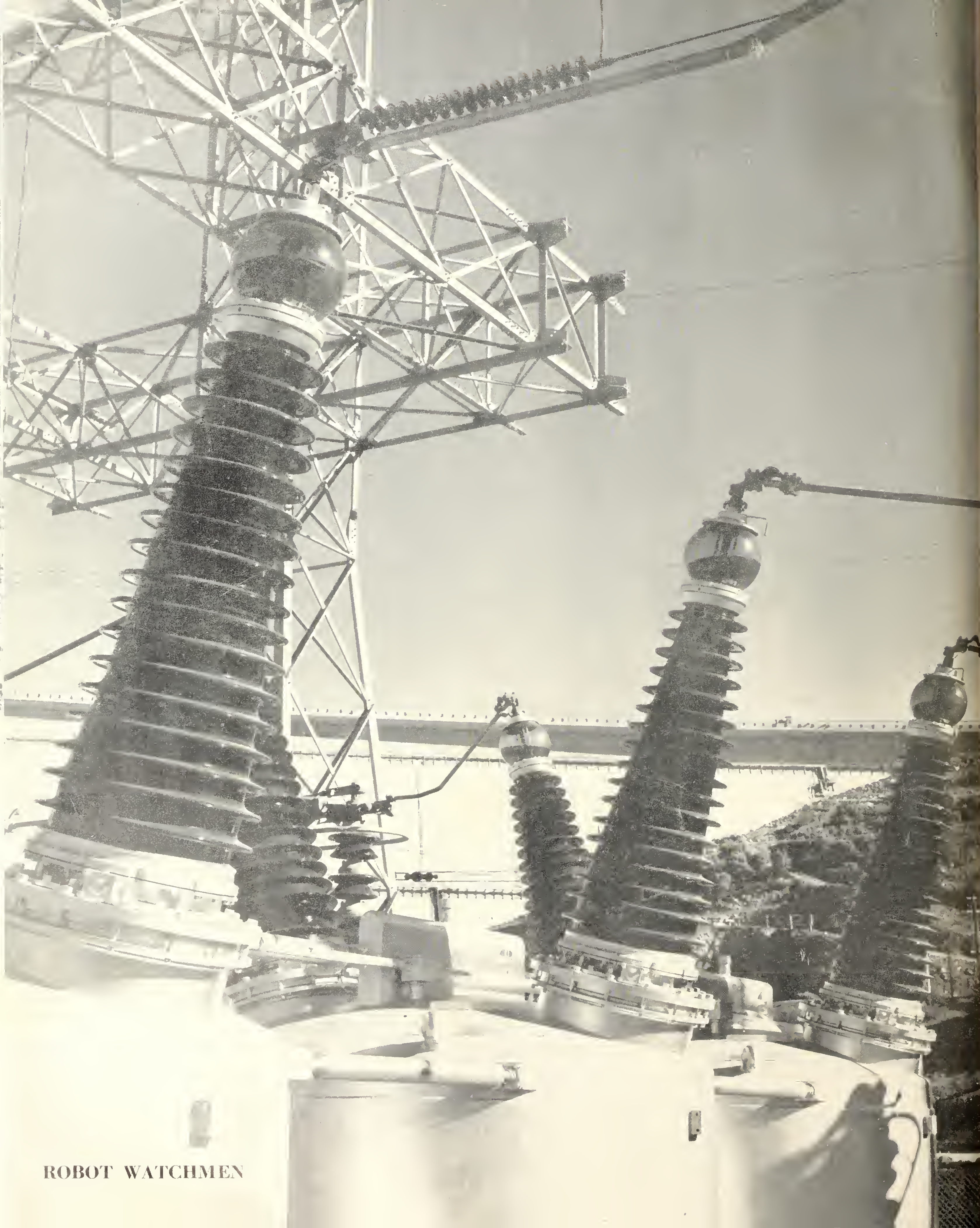
Regions (Space does not permit complete list of offices within the regions)

Regional offices	Field offices	Location	Official in charge	
			Name	Title
REGION 1—R. J. Newell, director, Boise, Idaho.	Central Snake (district).	Boise, Idaho	George N. Carter.	Acting district engineer.
	Anderson Ranch Dam.	Anderson Dam, Idaho.	Vacancy	Construction engineer.
	Deschutes	Bend, Oreg	C. H Spencer	Do.
	Yakima	Yakima, Wash	D. E. Ball	Superintendent.
	Roza division	do	H. Y. Nelson	Construction engineer.
	Columbia Basin	Coulee Dam, Wash.	F. A. Banks	Supervising engineer.
	Ephrata office	Ephrata, Wash	H. A Parker	Engineer.
	Project development.	do	W. W. Johnston.	Acting supervisor.
	Minidoka	Burley, Idaho	S. R. Marean	Superintendent.
	Palisades	Idaho Falls, Idaho.	I. Donald Jerman.	Project engineer.
	Hungry Horse	Kalispell, Mont	Paul A. Jones	Do.
	Umatilla	Pendleton, Oreg	C. L. Tice	Reservoir superintendent.
	Rathdrum Prairie.	Coeur d'Alene, Idaho.	Louis B. Ackerman.	Construction engineer.
	Bitterroot	Hamilton, Mont.	T. R. Smith.	Do.
	Missoula Valley	do	do	Do.
REGION 2—R. L. Boke, director, Sacramento, Calif.	Central Valley			
	Kennett division.	Redding, Calif	I. C. Harris	Acting construction engineer.
	Friant division	Friant, Calif	R. K. Durant	Do.
	Delta division	Antioch, Calif	O. G. Boden	Construction engineer.
	Klamath	Klamath Falls, Oreg.	E. L. Stephens	Superintendent.
	Orland	Orland, Calif	E. R. Asdell	Do.
	Project planning	Santa Barbara, Calif.	J. H. Fertig	Engineer.
REGION 3—E. A. Moritz, director, Boulder City, Nev.	All-American Canal.	Yuma, Ariz	J. K. Rohrer	Acting construction engineer.
	Gila	do	J. K. Rohrer	Do.
	Yuma	do	W. A. Boettcher	Superintendent.
	Coachella Canal	Coachella, Calif.	C. S. Hale	Division engineer.
	Boulder Canyon	Boulder City, Nev.	C. P. Christensen.	Director of power.
	Davis Dam	Kingman, Ariz	H. F. Bahmeier.	Acting construction engineer.
	Parker Dam Power.	Parker Dam, Calif.	S. A. McWilliams.	Construction engineer.
	San Diego	Escondido, Calif	R. B. Ward	Engineer.
	Project planning	Phoenix, Ariz	V. E. Larson	Assistant regional planning engineer.
REGION 4—E. O. Larson, director, Salt Lake City 8, Utah.	Eden	Rock Springs, Wyo.	E. V. Hillius	Chief clerk.
	Grand Valley	Grand Junction, Colo.	T. L. Sundquist	Superintendent.
	Mancos	Mancos, Colo	A. W. Bainbridge.	Resident engineer.
	Newton	Logan, Utah	E. J. Wick	Engineer.
	Pine River	Bayfield, Colo	S. F. Newman	Reservoir superintendent.
	Provo River	Provo, Utah	L. R. Dunkley	Construction engineer.
	Scofield	Price, Utah	P. R. Neeley	Do.
REGION 5—W. R. Nelson, director, Amarillo, Tex.	San Luis Valley	Monte Vista, Colo.	D. M. Forester	Project engineer.
	Valley Gravity	McAllen, Tex	C. P. Seger	Area planning engineer.
	Tucumcari	Tucumcari, N. Mex.	M. P. Starr	Acting construction engineer.
	Altus	Altus, Okla	H. E. Robbins	Construction engineer.
	Rio Grande	El Paso, Tex	L. B. Fiock	Project superintendent.
	Ysleta office	Ysleta, Tex	F. D. Postle	Division superintendent.
	Las Cruces	Las Cruces, N. Mex.	E. S. Mayfield	Do.
	Carlsbad	Carlsbad, N Mex.	T. B. Thomas	Acting project superintendent.
REGION 6—H. D Comstock, director, Billings, Mont.	Belle Fourche	Newell, S. Dak	S. T Larsen	Superintendent.
	Buffalo Rapids	Terry, Mont	W. I. McClure.	Acting construction engineer.
	Fort Peck	Fort Peck, Mont	Allen Mattison	Resident engineer.
	Intake	Terry, Mont	W. L. McClure	Acting construction engineer.
	Milk River	Malta, Mont	H. W. Genger	Superintendent.
	Rapid Valley	Rapid City, S. Dak.	H V. Hubbell	Construction engineer.
	Riverton	Riverton, Wyo	D. L. Carmody	Superintendent.
	Shoshone	Powell, Wyo	L. J. Windle	Do.
	Heart Mountain division.	Cody, Wyo	W. L. Kemp	Construction engineer.
	Sun River	Fairfield, Mont	C. L. Bailey	Superintendent.
	Missouri River			
	Project development staff.	Billings, Mont	W. E. Rawlings	Supervisor.
	Boysen Dam	Thermopolis, Wyo.	R. S. Lieurance	Project engineer.
REGION 7—E. B. Debler, director, Denver, Colo.	Colorado-Big Thompson.	Estes Park, Colo.	C H. Howell	Do.
	Mirage Flats.	Hemingford, Nebr.	D. J. Paul	Construction engineer.
	North Platte district.	Casper, Wyo.	I. J. Matthews	District engineer.
	Missouri Basin			
	Frenchman-Cambridge.	McCook, Nebr	H. E. Robinson	Project engineer.
	Kortez (under North Platte district).	Casper, Wyo	I. J. Matthews	District engineer.
	Project planning	Grand Island, Nebr.	P. L. Harley	Engineer.
	do	Pueblo, Colo	B. F. Powell	Do.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo.	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D. G. Leslio	Superintendent.	C. J. McCormick	Grand Junction, Colo.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Noval T. Kitchen	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonauza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.

(Continued on page 188)



ROBOT WATCHMEN

SEPTEMBER 1946

This Issue:

RRALLING *THE LORADO*

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VING DAY *GRAND ULEE DAM*

•

AMP LIFE *AT VIS DAM*

E *Reclamation* ERA

Reclamation ERA

Vol. 32 SEPTEMBER 1946 No. 9

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Contents

Front cover photograph by L. R. Murphy, photographer, Region III. Back cover photograph by K. S. Brown, photographer, Region I. Art work by Georgie Petty.

Our Front Cover

"Yes, Sir! That's a Good Job!"

As Labor Day, 1946, comes around, we honor the men whose brains and brawn have made possible the construction of the Bureau of Reclamation's projects. From the smallest precision instruments to the greatest structures of concrete and steel, American genius and initiative have written a stirring chapter in the history of our country. No wonder this young signalman smiles with pride. To him and all the others who have contributed to the prosperity of America's Reclamation areas, a sincere, "Well done!"

(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of ______________ for a __________ year subscription to the RECLAMATION ERA.

Sincerely,

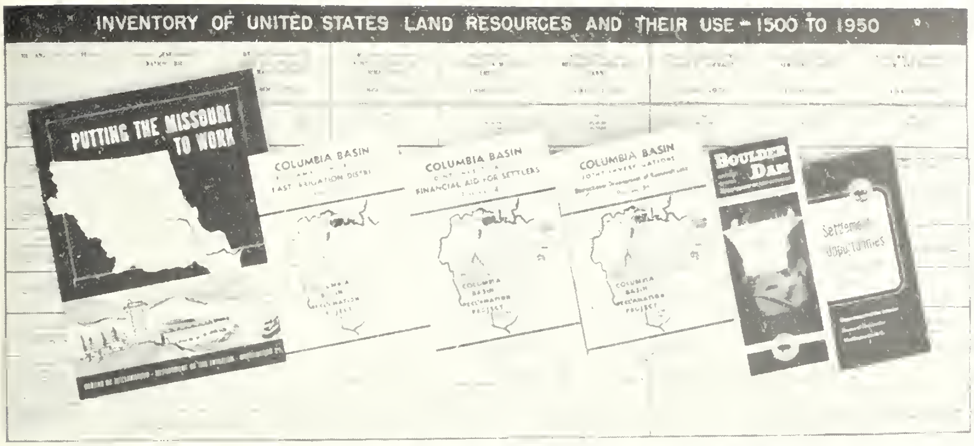
Check (√) if member of water users association ☐

(Name)

(Address)

(Include zone number, if any)

(Name and address of association)



RECLAMATION'S BOOKSHELF

Recent Bureau Publications

1. *Inventory of United States Land Resources and Their Use—1500 to 1950.*—A chart for wall display and study. To be obtainable soon from the Superintendent of Documents, Washington, D. C.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are:
   Problem 14, *Financial Aid for Settlers*—25 cents.
   Problem 26, *Recreational Development of Roosevelt Lake*—75 cents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the East Columbia Basin Irrigation District—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy from the Superintendent of Documents, Washington, D. C.

4. *Maps of Seven States Showing Water Resources Development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to Regional Directors at Region VI and VII.

5. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy from the Superintendent of Documents, Washington, D. C.

6. *Approved Missouri River Plan Map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

7. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to your Regional Director.

8. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ending June 30, 1945). Obtainable on request to the Bureau of Reclamation as directed above.

9. *Boulder Dam.*—Illustrated folder on the world's highest dam. Obtainable on request to the Bureau of Reclamation at Washington or Boulder City, Nev.

Miscellaneous Publications

Rock Tunneling with Steel Supports by R. V. Proctor, vice president and general manager, and T. L. White, chief engineer of design, the Commercial Shearing & Stamping Co., Youngstown, Ohio. According to the authors, "this book is intended to be helpful to the designing engineer in the drafting room, the resident engineer on the job, and the contractor, his project engineer and his superintendent;" 271 pages with illustrations: Youngstown Printing Co., Youngstown, Ohio: 1946—$2.50.

"Run-off Forecast—1946 Water Supply in Western States" in *Western Construction News*, May 1946, page 107. According to the forecast, "Mountain and Pacific States may expect run-off this year to equal or exceed long-term average, but southern drainage basins will receive subnormal supplies, becoming increasingly severe moving toward Arizona, Southern California, Southern Utah and New Mexico—storage will ease the situation." Illustrated.

"Soil Conservation Districts Are Rendering Basic Service to Nation" by Curtis R. Fuller, in *Western States Reclamation Journal*, May 28, 1946, page 8. A well-illustrated study of the value of the soil conservation district.

"Mexican Irrigation Commission" by Associate Editor Dorothy M. Tercero, in the *Bulletin of the Pan American Union*, May 1946, page 265. According to the author, the Mexican Irrigation Commission during 1941–45 irrigated or improved almost 900,000 acres, and, by the end of 1946, expects to have completed work that will irrigate or improve approximately 800,000 acres more.

Letters to the Editor

July 9, 1946.

Dear Sirs: It is indeed a great pleasure to be able to read again month after month your publication, Reclamation Era. Appearing in new and improved form with the May 1946 issue after ceasing publication with the April 1942 issue, it brings to me a vivid picture of activities in American reclamation such as no other source of information can convey. I want to thank herewith personally all men who made it possible to renew publication of Reclamation Era.

As to material in issues during the current year, may I see articles on the work the Bureau of Reclamation has done to aid in the war effort? For instance, what might the outcome of the war or a delay in end of war have been if there had been no men with the foresight to build such great power plants as Boulder, Grand Coulee, Bonneville and others which supplied the energy to make materials of war.

Taking advantage of your offer to permit reprinting, I am planning to use the article, "Wanted: Men to Hire" in an early issue of The International Engineer, using with the article the map shown on page 113 of the May 1946 issue.

Cordially yours,

John H. D. Blanke,
Technical Editor,
The International Engineer.

(Editor's Note: Reader Blanke's attention is called to the Era's "Giants in Peace and War" in the June issue. We appreciate his comments and are glad to receive suggestions such as these from our readers. This is your magazine, dedicated to the reclamationists of the West. We want to hear from our readers so that we can best serve them.)

Single Copies of the *ERA* Available

For the benefit of our subscribers and others who would like to purchase single copies of particular issues of the *Reclamation Era*, the following single copy rates have been established:

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10 to 50 copies	10
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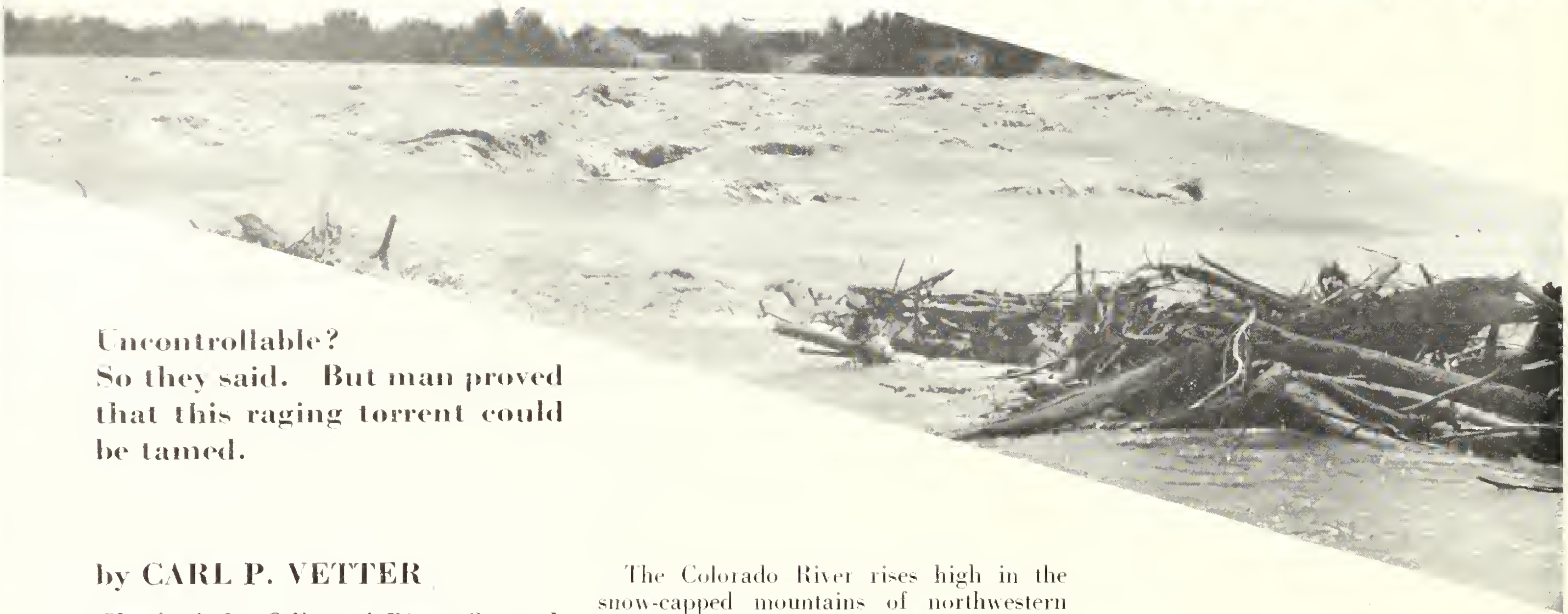
CORRALLING THE COLORADO



**Uncontrollable?
So they said. But man proved that this raging torrent could be tamed.**

by CARL P. VETTER

Chief of the Office of River Control, Region III

It is well for all who live in the great Southwest to realize that the Colorado River is the very lifeblood of the country in which they reside.

Without the river as it is developed today, the entire region of southern California, east of the coastal range, and a major part of Arizona would be an arid waste, inhabited as it was in years past by a few prospectors, miners, and trappers.

Garden of Eden

There would be no Imperial Valley from which come the winter vegetables and the many other products growing so abundantly in that region at seasons of the year when the major portion of the country is covered by snow and ice.

There would be no Coachella Valley which grows almost all the dates commercially produced in the United States.

There would be no Palo Verde Valley, nor Yuma Valley, where thousands of acres of fertile land are under intensive cultivation.

There would be no industrial empire along the coastal fringe of southern California—in fact there would hardly be sufficient water to drink. Certainly there would be no possibility for an increase of population beyond that which lived there before the war. The tremendous production of planes and ships and other war materials in the Southwest during the last 4 years would not have been possible. The great Basic Magnesium Plant in Nevada could not have been established, and Las Vegas would have had no future as an industrial community.

The Colorado River rises high in the snow-capped mountains of northwestern Colorado, flows for nearly 1,400 miles in a southwesterly direction, and finally pours into the Gulf of California in Mexican territory not far beyond the International Boundary. It is the third longest river in the United States.

Along its course the Colorado River has gouged mighty canyons, the like of which are not found along any other river in the country. The world-famous Grand Canyon is a titanic chasm over 200 miles long, a dozen miles in breadth, and a mile deep.

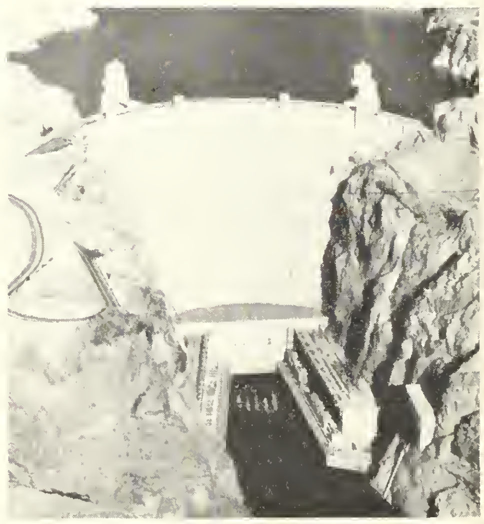
The Colorado River drainage basin covers an area of 244,000 square miles, of which 242,000 are in the United States. Stretching from Wyoming to below the Mexican border, the basin has a total length of some 900 miles, including nearly all of Arizona, and large portions of California, Colorado, Nevada, New Mexico, Utah, and Wyoming—an area equal to one-twelfth of the land area in the United States.

River on a Rampage

Before man began his attempt to control and regulate the river, violent floods descended the stream, fed by melted snow of the high mountains. They inundated low-lying lands along the banks of the river, drowning cattle and destroying property; but in so doing they spread over the inundated land layers of fine and fertile silt which represent the priceless top soil eroded from other parts of the drainage basin. These deposits now form the rich valleys along the river, such as the Palo Verde Valley in California and the Yuma Valley in Arizona.

Picturesque as is the scenery found along the course of the river from the pine-scented forests of the high Rockies to the burning sands of the desert, so is the history of the river colorful and intriguing. Along the banks of its tributaries, particularly in Arizona, are found the traces of bygone races of which we only know that they came—we know not from where, that they lived along the banks of the river and that they left—we know not why nor when.

In 1540, a Spaniard, De Alarcon, discovered the Colorado River and sailed up the stream to a point near where the city of Blythe is now located. Two years later another Spaniard, De Cardenas, discovered



THE CITADEL—Boulder Dam

Editor's note:—On September 30, 1935, eleven years ago, the late President Franklin Delano Roosevelt dedicated this great structure to the service of mankind.

the Grand Canyon but was unable to descend its sheer walls. As time passed the stories of these early Spanish explorers, combined with Indian legends, grew into fabulous tales of this unknown land. It was said that the Colorado had great falls and whirlpools, and that it ran underground for hundreds of miles. So formidable were the obstacles said to be that for nearly 200 years travelers would carefully circumvent or avoid the dangerous river.

The exploration of the Colorado River by North Americans began in 1824 with the expedition of General Ashley, and was followed by others such as the renowned Kit Carson and Captain Bonneville during the twenties and thirties of the last century. By 1840 this great wilderness, except for the deep canyons, had been traversed throughout by white men.

Navigation was the first use made of the main Colorado River. Steamboating began on the lower river with the establishment of Fort Yuma in 1850. Before the coming of the railroads, all freight for the interior of Arizona was carried by seagoing ships to the head of the Gulf of California where it was transferred to the river boats and shipped to various points along the lower river from which it was carried overland by wagon train to its final destination.

Early Explorations Fail

In 1857 the War Department dispatched Lt. J. C. Ives to proceed up the Colorado by boat as far as navigation was possible. He ascended in his steamboat as far as Fort Callville near the head of Black Canyon, about 400 miles above the mouth of the river. It took him 5 days to navigate the last 20 miles.

In his report to the War Department Lieutenant Ives said: "the region last explored is, of course, altogether valueless. It can be approached only from the south, and after entering it, there is nothing to do but leave. Ours was the first, and doubtless will be the last, party of whites to visit this profitless locality. It seems intended by Nature that the Colorado River along the greater portion of its lone and majestic way shall remain forever unvisited and unmolested."

Fortunately, men of sterner stuff followed the trail blazed by Lieutenant Ives. In 1869, Maj. J. W. Powell of the Geological Survey succeeded in leading a river expedition down through the canyons of the river. In traveling by boat from the Green River in Utah, to the mouth of the Virgin River in Nevada, a few miles above where Lieutenant Ives had been stopped, he achieved the hitherto impossible feat of traversing a thousand miles of unknown rapids and formidable canyons. He became the first white man to gaze up the sheer walls of the Grand Canyon throughout its entire length and live to tell the tale.

The first white irrigators in the basin were the Jesuits who established themselves at the old missions in Arizona in 1732. In 1856, Thomas H. Blythe acquired some 40,000 acres of land in Palo Verde Valley in California and constructed an irrigation system to water a considerable area from the river. At about the same time, the first modern irrigation works were being constructed in Utah, Wyoming, and Colorado.

The possibility of bringing water from the Colorado River to the Imperial Valley of California by a simple diversion canal passing in part through Mexico was recognized even before the Civil War. In 1876, Lt. Eric Bergland made surveys on the lower river for the War Department for the purpose of investigating flood conditions and determining the feasibility of diverting water from the river to the Imperial Valley through a canal wholly within the United States. He reported unfavorably on such a canal but efforts continued for a water supply to the Imperial Valley. Despite the difficulties and undesirability of a canal through Mexico for irrigation of Imperial Valley, construction of an international canal was finally begun in 1902. By September 1904 nearly 8,000 people had settled in the valley, 700 miles of canal were in operation, and 75,000 acres of land were cropped.

Benefits Wiped Out

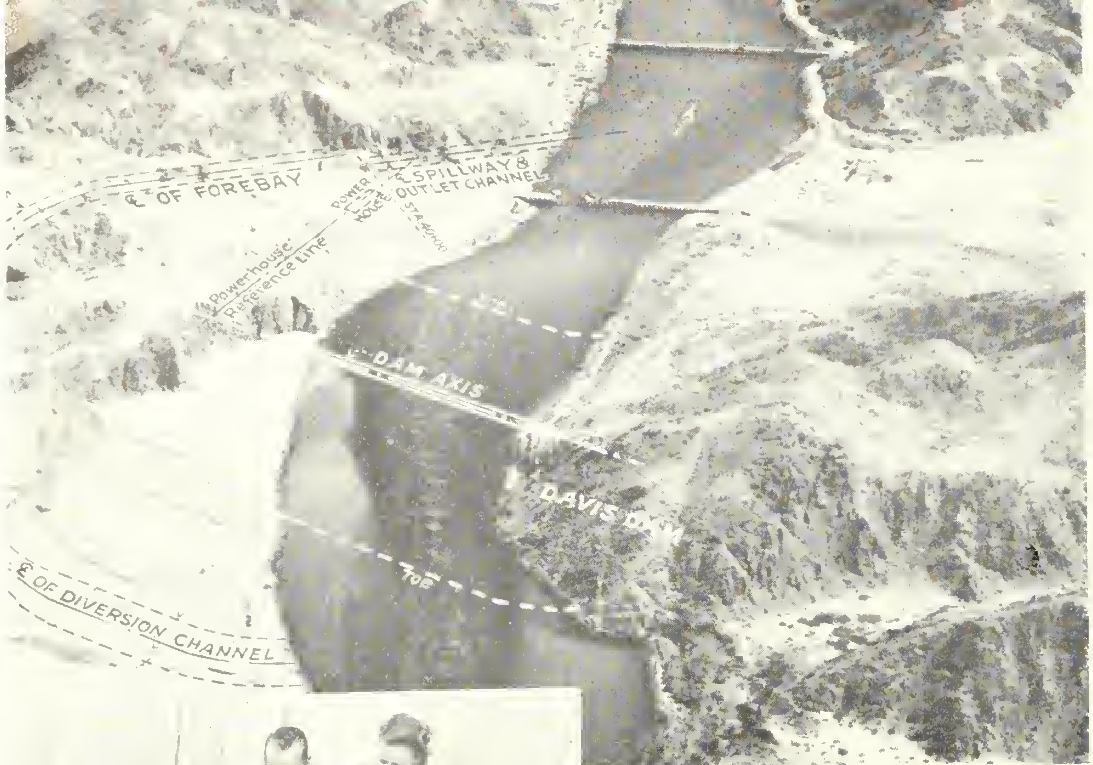
As the benefits from the river began to spread, so also began the destruction from its floods. The tragic menace from these floods was not realized fully until 1905 when the river, swollen from rains, burst its banks 4 miles below the International Boundary and for 16 months poured its entire flow into Imperial Valley's sunny fields and flourishing communities. It enlarged the Salton Sea to a lake 76 feet deep and 488 square miles in area, and threatened permanently to engulf the entire valley. The break was finally closed in 1907 with great difficulty and expense by the Southern Pacific Railroad at the request of President Theodore Roosevelt, but not before some 30,000 acres of arable land had been inundated. Farms had been ruined, homes destroyed, highways washed away, and railroads wrecked. Miles of main-line railroad track had to be moved to higher ground, and tangible damage into the millions of dollars was sustained. Here, in the need for flood control, was the prime motivating reason for the construction of Boulder Dam.

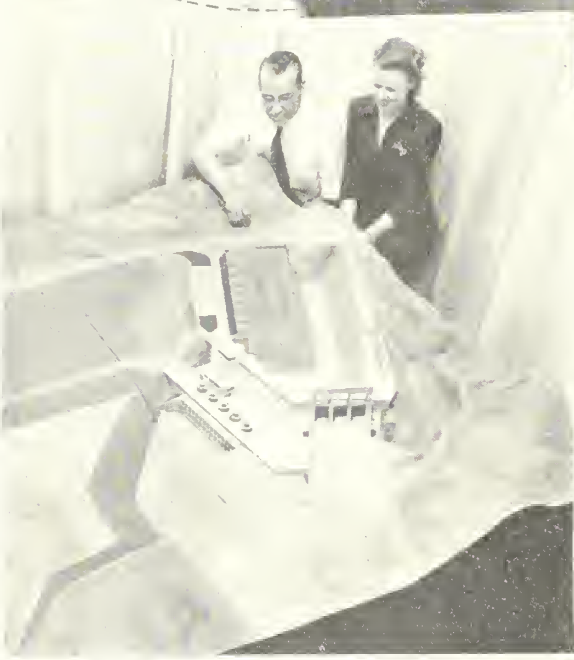
Protection of the lands lying below the flood stage of the Colorado had required the building of levees against which each year the river with its silt-laden floods lashed. The levees were built higher and stronger. Although the levees were necessary to protect lands both in the United States and Mexico, many were located in Mexico. The maintenance of these levees, complicated by international problems, was an expensive burden.

Levees on the Colorado

Levees constructed to protect the Yuma project on the Colorado just north of the International Boundary line were broken several times with disastrous local results. A flood occurred in 1922 which broke the levees along the Palo Verde Valley in California. From 1906 to 1924, 10¼ million dollars were spent by various agencies on levee construction and maintenance on the lower Colorado River, including protection for Imperial Valley. Even this large expenditure did not eliminate the menace.

THE AMBASSADOR—Imperial Dam where life-giving water which flows into the All-American Canal pours into the Imperial Valley and, strictly according to protocol, can be dropped into neighboring Mexico.





THE COMING COLOSSUS—Davis Dam

Above, a bird's-eye view of proposed features of the Davis Dam project, complete with engineers' indications of what will go where.

At left, the whole works in miniature. How big? One inch equals 25 feet.

The continued threat of a major break from some unexpected river change still remained and 100,000 people lived in constant fear of the ever-threatening river.

Perseverance Pays Off

As the years went by it became apparent that drastic steps would have to be taken to eliminate as far as practicable the almost yearly occurring damages due to floods or drought. The Boulder Canyon Project Act was finally passed by Congress in 1928, after many thorough and painstaking investigations. This act provided for the construction by the Bureau of Reclamation in Black or Boulder Canyons of a dam of unprecedented magnitude which would hold back the floods and provide the greatest practicable amount of water for irrigation. The construction of the dam was also intended to improve navigation of the river. By the time the act was passed, however, there was no longer any navigation such as had been seen during the past century before the coming of the railroad and the automobile.

In February 1935, the bypass gates of Boulder Dam were closed, and the control of the Colorado River began.

Boulder Blazes Trail

The construction of Boulder Dam was followed by the construction of other dams on the main stream of the river. These dams are Parker Dam, which forms a pool from which water is pumped for the Metropolitan Water District of Southern California; Headgate Rock Dam, which is a diversion dam for the Colorado River Indian Reservation near Parker; the temporary weir near Blythe, which aids diversion to the Palo Verde irrigation district; Imperial Dam, north of Yuma, which is a diversion dam for the All-American Canal; and Laguna Dam, 5 miles below, which used to be the diversion dam for the Yuma irrigation district in California and Arizona and which is still used by private irrigators on the Arizona side of the river.

Thus, while the flood menace on the Colorado River below Boulder Dam has been largely eliminated and the maximum possible amount of water has been made available for irrigators, many problems still remain to be solved. These problems originate mainly from the large quantity of silt which was carried by the river and which is still entering Lake Mead, formed by Boulder Dam, and is now deposited there.

Silt Creates Problem

Before construction of Boulder Dam, an average of approximately 16 million acre-feet of water which yearly passed down the lower river carried an average of 150 million tons of silt. As an illustration, these 150 million tons of silt amount to some 5 million railroad carloads a year or some 14 thousand carloads a day. As this enormous silt load is deposited in Lake Mead, clear water is discharged below the dam; but the river bed, which for thousands of years has adjusted itself to the transport of silt-laden water, is now too steep for the clear water and in its attempt to adjust itself to the new conditions, it creates many difficulties. These require intensive study and expensive construction for their remedy. These studies are now under way by the Region III Office of River Control, and it is anticipated that the Congress will provide funds for the execution of the necessary work.

Maximum development of the Colorado River is necessary not only for the economic stabilization and growth of the Colorado River Basin, but also for the benefit of the entire Nation. True national prosperity can be achieved only by prosperity of all component parts of the integrated economic system. The Colorado River Basin with its sun-drenched, agriculturally wealthy lowland, its high, mineral-rich mountains, its abundance of hydroelectric energy in the rivers, its ready access to the great seaports and manufacturing cities on the west coast, and its delightful climate can be developed into one of the most prosperous sections of the country.

This is the first of a series of articles on the Colorado Basin, the first two of which will be based on the Department of the Interior's "THE COLORADO RIVER"—a Project Planning Report which has been sent for review to the Governors of the affected States, the Secretary of War, and other interested officials. The departmental report will be released to the people of the affected areas late this month or early in October. Later the departmental report, accompanied by the reviews of the authorities concerned, will be presented to the Congress for action.

Moving Day at Grand Coulee Dam

by DONALD D. McGREGOR

Mechanical Engineer, Grand Coulee Dam Power Plant

One of the biggest transfer jobs in history is nearing completion at the Grand Coulee Dam power plant. Two 75,000-kilowatt generators and their 103,000-horsepower turbines, originally intended for installation in the Shasta power plant, were transferred to Grand Coulee for war service. Now they are going back. Never before have generating units of this size been so unceremoniously uprooted and transferred to another power plant. However, this is jumping into the middle of the story. Let's go back to the beginning.

During those tense days following December 7, 1941, war industries were mushrooming in the Northwest. The large, new alumina-reduction plants, the aluminum rolling mills at Spokane, and the shipbuilding and aircraft plants along the west coast all were taking large blocks of power and predicting greater future needs. With Bonneville power plant already nearing its ultimate capacity, only the Grand Coulee power plant was left to absorb the expanding load.

FRONT LINE REPLACEMENTS. Dwarfed by the permanent giant generators at Grand Coulee Dam power plant, the Shasta units in the foreground staunchly did their bit during the war.

The first three main units at Coulee, rated at 108,000 kilowatts each, were operating at overload, and three more units were under an accelerated installation schedule calling for their operation late in 1943. However, this would still be too little and too late.

Thus it was that Bureau of Reclamation engineers looked longingly at the three empty turbine pits in the left powerhouse. These were designed to house the seventh, eighth, and ninth main units in the Grand Coulee power plant. If these potential sources of power could only be tapped by some quick method, the battle of power supply might be won. "Why not use the Shasta units?" someone asked.

Work had been stopped on Shasta Dam and power plant by the scarcity of materials. Two 75,000-kilowatt generating units had been manufactured for Shasta. One was at the factory and the other already in California. But they would not be able to produce any power at Shasta until after the war was over. By installing these two units in the Grand Coulee power plant, the benefits of their capacity would be utilized during the war. The transfer and subsequent removal of these units would be costly from a strictly economic standpoint. However, the engineers argued that if the war could be shortened by a day or even an hour by this transfer, the saving of lives alone would justify the cost.

Late in April 1942, transfer of the two Shasta turbines and generators was approved by the Commissioner of Reclamation. This immediately presented some major problems. The first was that the left powerhouse at Grand Coulee Dam was designed for turbines which turn clockwise, and consequently the penstocks enter the turbine pits on the left side, while the Shasta turbines turn counterclockwise and required the penstocks to enter from the right side of the turbine pit. This problem was solved by blasting through the 8-foot concrete wall between the turbine pits, and bringing the L–9 penstock into the right side of the L–8 turbine pit and the L–8 penstock through the wall into the right side of the L–7 turbine pit. This required the use of shree turbine pits for two machines, but could not be avoided.

The second major problem was that of the draft tubes, which had already been built as part of the left powerhouse foundation, specifically for the 108,000-kilowatt Grand Coulee units. The design of these draft tubes is very critical, and it was felt that placing the smaller turbines over the present draft tubes would cause severe, if not excessive, hydraulic disturbances. Model tests were made immediately by the manufacturer and a special liner or transition piece was made to connect the turbine and draft tube. This was the best that could be done in the short time allotted, and no one was too certain that the draft tubes would withstand any adverse hydraulic conditions.

On February 25, 1943, the first Shasta generating unit started sending power to the war industries, and on May 7, 1943, it was joined by the second unit. Each of these

DEMOBILIZATION BEGINS. Above, slowly and carefully, concrete is chipped by hand from the scroll case serving one Shasta Units.

units, although rated at 75,000 kilowatts, was able to produce 84,000 kilowatts continuously, and when the aluminum plants or shipyards needed a little extra power it was possible for each unit to produce up to 92,500 kilowatts until the peak demand was over. As had been predicted, there were hydraulic disturbances in the draft tube, but fortunately no extensive difficulties developed. No major repair was necessary to either machine during their tour of duty at Grand Coulee power plant.

On December 3, 1945, the second Shasta generating unit installed turned out its last kilowatt in the Grand Coulee power plant, and dismantling was started immediately. Almost a month and a half later, on January 16, 1946, the other Shasta unit was taken out of service, and its removal was started.

A glance at the records shows that the "borrowed" generating units together had fed 3,043,686,000 kilowatt-hours of energy to the war industries of the Northwest. This figure is too large to be readily appreciated, so let us look at it from a different viewpoint: If one of our modern steam plants were to turn out this amount of energy it would require the burning of approximately 1,250,000 tons of coal. This amount of coal transported by railroad would take 25,000 cars, and would make a train over 200 miles long. What would be more interesting to know, however, is the effect this great block of power had on the war. It did shorten the war. This power went directly to the production of plutonium for atomic bombs at the Hanford plant in Washington State, to aluminum plants and aircraft plants for the building of bombers, and to shipyards for the building and repair of our Navy and supply ships.

The mechanical and electrical dismantling of these units was largely routine. Parts were removed, cleaned, repaired, identified, and prepared for shipment. The big job involved was the removal of 6,575 cubic yards of temporary concrete, which supported the generators and embedded the turbines. By drilling rows of holes and then stressing sections with wedges and hydraulic jacks, most of the concrete was broken out in large blocks, some of which weighed as much as 87 tons. These blocks were then placed on railroad cars and removed the powerhouse. Around the turbine cases and draft tubes, however, m the concrete had to be removed by operated chipping guns, a slow an cult job.

Dust from the drilling and chippi controlled by partitioning off all e tion areas, and by recirculating through a water spray.

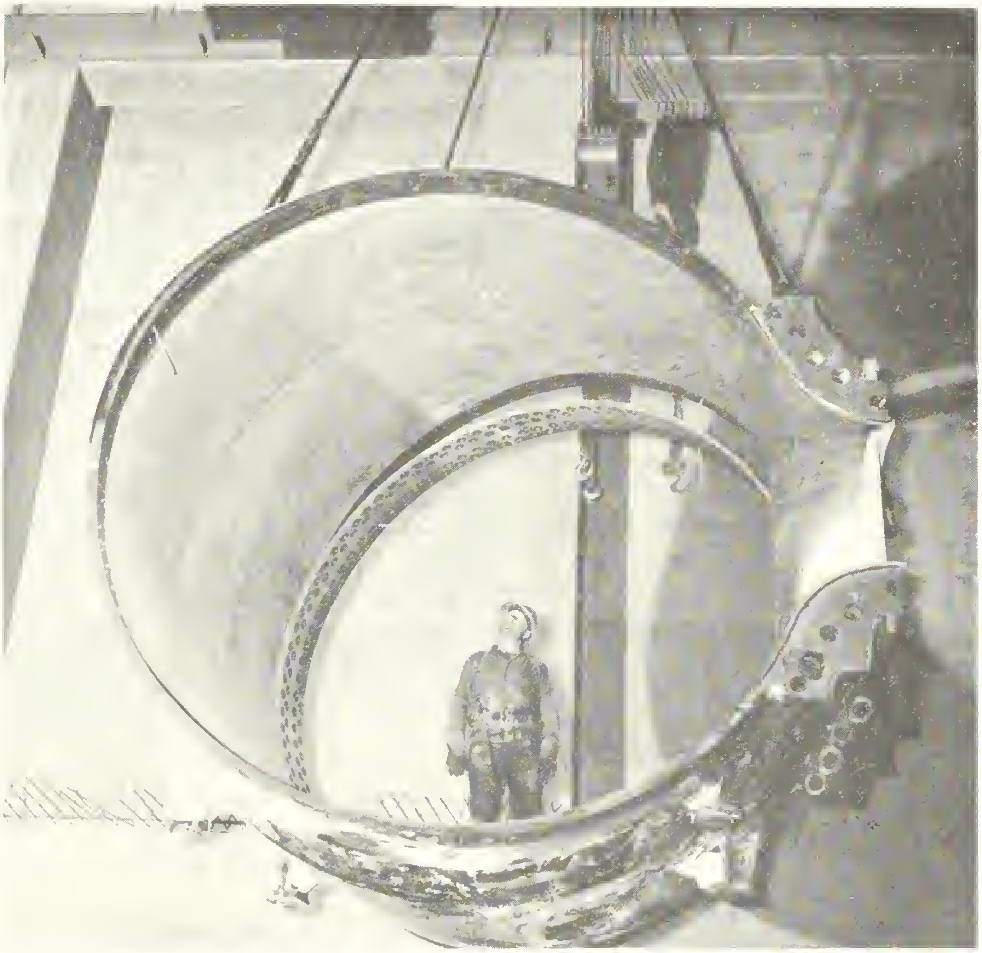
This proved insufficient because discharged from the air tools rais pressure in the working area above the rest of the powerhouse, with cons flow of air and dust through cracks partitions. To overcome this, fans w stalled to draw air from the part area. These offset the discharge fr tools, and thus kept fresh air flowi the excavation area at all times.

Many carloads of turbine and gen parts have already been shipped Shasta power plant. Ultimately, 9 road cars will be needed to trans parts of both units to their perman There they will be assembled to p power for peaceful development

Southwest, a sharp contrast with the war-sponsored industries they served from Grand Coulee power plant in the Northwest.

Although the pits used by the Shasta units will be occupied by 108,000-kilowatt giants, the engineers at Grand Coulee Dam are sorry to see them go. They liken them to two front-line soldiers, drafted when the war started, and assigned to duty far from home.

Their feelings are summed up by the statement of one employee: "These fellows certainly have traveled a long, long ways. But no matter how far they've been moved, they certainly have earned every cent of their fare."



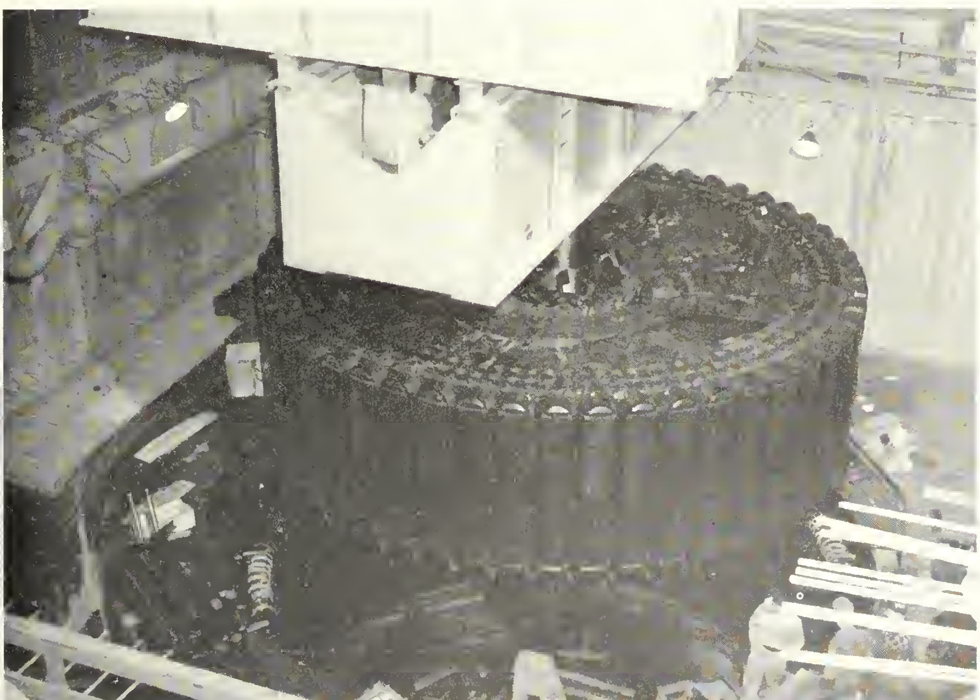
HEADS UP! Freed from its sheath of concrete, a 10-ton section of the scroll case is lifted from the pit.

War Relocation Centers Acquired

Three war relocation centers and a prisoner-of-war camp valued altogether at more than 30 million dollars have been transferred to the Bureau of Reclamation by War Assets Administration under provisions of the 1947 Appropriation Act.

These include the WRA centers at Klamath (Tule Lake, Calif.), Shoshone (Heart Mountain, Wyo.), Minidoka (Hunt, Idaho), and the former prisoner of war camp at Indianola, Nebr. There are 3,340 buildings in the three centers.

The buildings, furnishings, and equipment will be utilized in the veterans' settlement and construction programs of the Bureau under disposal regulations being formulated by the Secretary of the Interior.



READY TO GO. The 450-ton rotor of Shasta Unit L-7 leaves its temporary quarters to go back home to California.

Silt Solution Sought

The Bureau of Reclamation is undertaking broader investigations of stream bed and reservoir siltation in cooperation with other agencies. Studies will include movement of suspended sediment in the stream, bed-load transport, factors affecting the configuration of river channels and continuation of studies of sedimentation at the toe of dams.

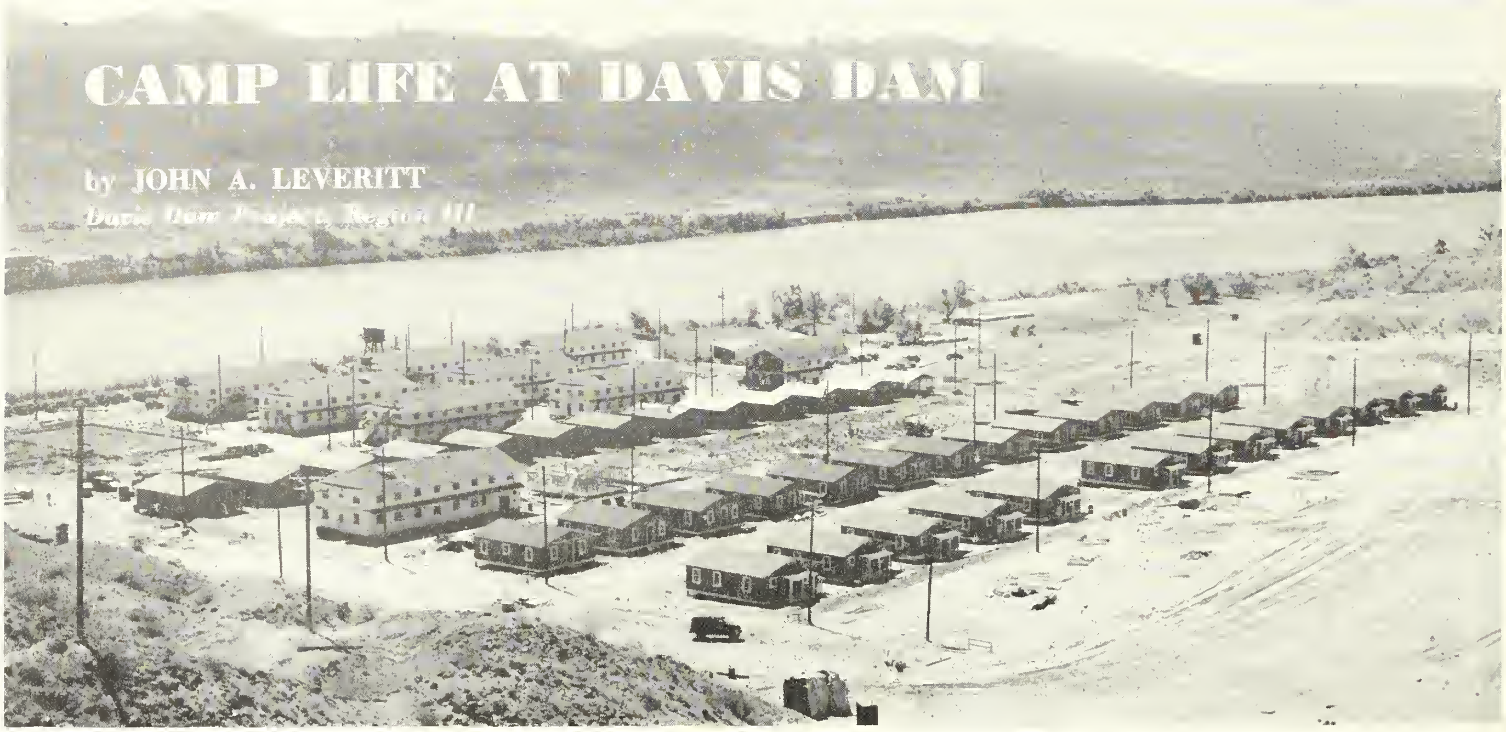
To instigate broad cooperative investigations of the problems concerned in the aggrading channel of the Rio Grande, a meeting was recently concluded in Albuquerque, N. Mex. The Bureau of Reclamation also participated in a meeting of the Subcommittee on Economic Effects of Reservoir Sedimentation of the American Society of Civil Engineers at Spokane, Wash., during July.

Lewiston-Orchards Authorized

Construction of Lewiston Orchards project, Idaho, has been authorized with the proviso that the costs allocated to irrigation and to municipal water supply shall be reimbursable under the Federal reclamation laws within a repayment period at the discretion of the Secretary of the Interior, but not to exceed 50 years.

CAMP LIFE AT DAVIS DAM

by JOHN A. LEVERITT
Davis Dam Project, Region III



Mushrooming on the Nevada side of the Colorado River is the Utah Construction Company's camp for workers at the Davis Dam site. Shown are most of the 50 two-bedroom houses and 10 former Army barracks where the workers will live during construction.

A major construction project in the sparsely populated West usually means the birth of a new community and Davis Dam on the Colorado River is no exception.

The dam site is 67 miles below Boulder Dam and when construction began early this year there were only a few prospectors and ranchers in the area. It is estimated that there will be around 2,200 people in the immediate vicinity during most of the construction period.

"Since the dam site is 34 miles from Kingman, Ariz., the nearest town of any size, the Bureau of Reclamation had to include a complete city in the planning of the project so that adequate personnel would be attracted," declares Construction Engineer H. F. Bahmeier.

Two camps to provide the necessities and comforts of life for the dam builders and their families, one for Government employees and the other for employees of the main contractor, are being established. The shortage of material for housing has made it difficult to construct the camps, but, guided by expediency, the Bureau and the contractor have been able to go ahead with the construction of the camps and they will be ready for full occupancy in the near future.

Under the contract for the construction of the dam, powerhouse, spillway, and appurtenant works, the Utah Construction Co., the contractor, is obligated to "provide, maintain, and operate, under competent direction, such camps and facilities, convenient to the work, as are necessary for the housing, feeding, and accommodation outside of working hours of employees."

The Government camp is about 3 miles downstream from the dam site on the Arizona bank of the river and the other camp is directly across the river. Part of the Government camp will be maintained on a permanent basis for occupancy by the operation and maintenance personnel on the project after it is completed. For this reason paved streets, curbs, gutters, sidewalks, and other utility facilities of a permanent nature are being provided in this camp.

In addition to the temporary housing, offices, and laboratories, there will be 40 permanent houses, a garage and fire house, and several other buildings. A contract for 20 of the permanent houses, a garage and fire house and several other buildings has been let and the other 20 will be built later. Most of the work has been completed on the utility facilities, but construction of the housing has been held up a great deal because of material shortages.

Construction of the contractor's camp has been expedited and is nearing completion with hundreds already occupying quarters. Because of the lumber shortage the contractor has resorted to the purchase of surplus war housing. Ten large Army barracks located at Camp Williston in Boulder City, Nev., were purchased. The barracks were cut in 20-foot sections and moved the 108 miles by highway to the dam site (see back cover, August *Era*). They are being divided into rooms and nine of them are for single men and the other for women.

Thirty-five units of a war housing project in Kingman, each containing five apartments, are being cut into sections and moved. Fifty trailers from the Navy's ordnance plant in Hawthorne, Nev., have been obtained and are being reconditioned for use. The contractor has also erected 50 two-bedroom houses of temporary construction, and a barracks for single men.

To provide meals for all the men on the job, including Government and other contractors' employees, a large mess hall, accommodating over 500 people, is in operation. Approximately 2,400 meals a day are served in the mess hall which is on a 24-hour schedule.

The mess hall is operated by Vic Leval, formerly banquet manager for the Hotel New Yorker in New York City. Leval obtained extensive experience in feeding construction workers during the war. He was steward on the Canol pipe-line project in Alaska, and served approximately 25,000 meals a day during the construction of the Shumaker naval ordnance plant at Camden, N. J.

Normally a construction worker eats 6 pounds of food a day, says Leval. During the hot summer months when the temperature reaches as high as 115 degrees, and over 105 nearly every day, the heat puts a damper on the men's appetites, however, and they eat only 3½ to 4 pounds a day.

The Government is granting no concessions at the dam site since that function has been delegated to the main contractor. By terms of the contract the contractor is permitted to lease buildings for conducting such businesses or services as may be required for the convenience of the residents of the camps.

A large general store will be constructed on the Arizona side of the river near the Government camp. It will include a gro-

MAIN STREET—Bullhead City, Ariz. It started with two houses, is this size now, and local people say, "Wait! This is only the beginning!"

COME AND GET IT! Over 2,400 meals a day served here. From left to right are Vic Leval, William Bechtel, and Bill Ketron in the camp kitchen.

cery store, butcher shop, shoe repair shop, drug store, soda fountain, jewelry store, and barber and beauty shop. This store will be of temporary construction since the permanent shopping center, if one is provided for the Government camp, will be in a different location.

The Utah Construction Co. is providing a large recreation hall in its camp for the leisure time of the workmen. The hall will contain a sandwich shop and a men's clothing store. The other concession which has been granted is for a service station at the Nevada end of the bridge which connects the two camps.

The contractor is obligated to make all necessary arrangements with the proper State and county authorities for school facilities and instruction, up to and including the twelfth grade, for children of its employees and Government employees. Negotiations are under way with ministers of several denominations for the establishment of chapels in the camps.

Bill Ketron, camp manager for the contractor, estimates that the population of the camp will average 1,500 people. He is experienced at construction camp management. During the construction of the Alcan Highway he managed as many as 20 camps, housing 2,200 men with his headquarters in White Horse, Alaska.

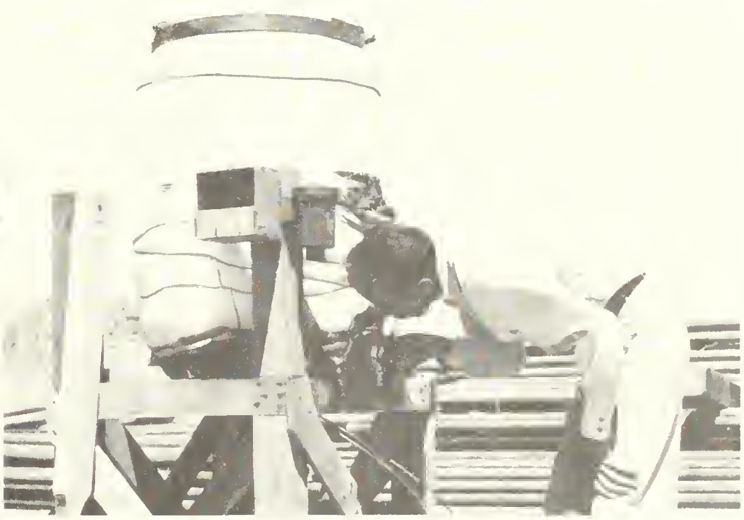
Although the Government and the contractor are providing the camps, another community has sprung up near the dam site. It is Bullhead City, Ariz., several miles downstream from the Government camp on the only privately owned land in the vicinity. It is a typical boom town with tents and trailers providing most of the living quarters. There is also considerable construction of permanent buildings. Residents of Bullhead City are optimistic about the future of the town, claiming that traffic on the highway which will cross the river at the dam, recreation facilities and possible irrigation developments in the vicinity will provide a sound economy for a small town.

During the first few months of the construction period the labor turn-over was excessive. Personnel men of the Government and contractors attributed this mainly to the lack of living accommodations. However, though the turn-over has been high, there has been a sufficiency of labor in most categories.

"Cooler weather and the completion of the camps is bringing that turn-over rate down and the contractors are confident that they will be able to maintain an adequate force to prosecute the work," says Mr. Bahmeier.

SCOW FOR SALE. A salesman's golden opportunity is found in Bullhead, where people will buy practically anything.

ROLL OUT THE BARREL. Water is a necessity in the dry, hot climate where the temperature often reaches 130° F.



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UTAH ~ *Cradle of American Irrigation*

Anniversaries of two important milestones in modern irrigation history nearly coincide.

Next year the State of Utah will celebrate the one hundredth anniversary of the advent of the Mormon pioneers in Great Salt Lake Valley. The first large-scale practice of Anglo-Saxon irrigation also had its beginning in 1847 when those hardy pioneers diverted City Creek water to soften land for planting potatoes near the heart of what is now Salt Lake City, Utah.

This simple diversion of a stream to irrigate adjoining lowlands led to the second significant event in early irrigation history, namely, the first irrigation storage reservoir in the State of Utah, and believed to be the first in the United States.

This early structure, old Newton Dam, located in northern Utah, is 75 years old this year.

The original Newton Dam was built by the pioneers with ox- and horse-drawn scrapers. Construction began in 1871 when the farmers found they were unable to get enough water from a simple stream diversion. The site was on Clarkston Creek, 1½ miles upstream from the new Newton Dam, completed this summer under the supervision of Bureau of Reclamation engineers. The original Newton Dam has passed its term of usefulness and is today commemorated by a monument erected at Newton by The Daughters of the Utah Pioneers. A plaque on the monument reads:

"Located 3½ miles north of this marker the first reservoir was begun in 1871 and completed in enlarged form in 1886 after going out three times. Length of dam 127 feet, height 28 feet, made of earth and rocks, cost $10,000, reservoir length 1½ miles, capacity 1,566 acre-feet. Original building committee, Bishop William F. Digby, Franklin W. Young, Stephen Gate, Swen Jacobs, and John Jenkins. First caretakers and watermasters, John Griffin, A. P. Welshman, and Jonas N. Beck."

*THEY KNEW IT WHEN. Standing by the marker which commemorates the origina Newton Dam are the men who worked on it in the early days.**

Another early watermaster of the dam was Joseph J. Larsen, who was a youngster in Newton at the time of the dam construction. Two other natives of Newton, William J. Barker and Marcus J. Benson, who are now watching completion of the new Newton Dam, participated in construction of the original structure.

As farms requiring irrigation were continuing to increase and as local interests could not finance a more elaborate project, the new Newton Dam was authorized for Bureau construction under the water conservation and utilization program. More than three times the size of the former dam, this is an earth-fill structure with a capacity of 5,300 acre-feet to furnish new and supplemental water to some 2,225 acres of lan northwest of Logan, Utah.

Also part of the project is a distribu tion canal 4,000 feet long and of 25 second feet capacity. Other features of the projec are the East Canal, 2 miles long and o 9-second-feet capacity to serve lands on th east side of Clarkston Creek, and the High line Canal, 6 miles long and of 18 second feet capacity, to serve lands west of th creek.

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*Reading from left to right, William J. Barke and Marcus J. Benson, who with ox team an scraper helped build the dam, and Joseph J Larson, an early watermaster.

THE OLD. Looking upstream at the original Newton Dam.

THE NEW. View of the modern Newton Dam and camp area

WHEN THE GREEN LIGHT SAYS "GO!"

The Bureau of Reclamation Proves Its Ability To Handle a Huge Construction Program

HOW big a construction program can the Bureau of Reclamation roll up once it gets the "go-ahead" sign?

Until recently, this question was a matter for conjecture. Since VJ-day, however, and the lifting of wartime restrictions, the Bureau has shown what it can do when it shifts into high. Whether the lights show green, yellow, or red, the Bureau of Reclamation watches the signs and is ready to go into any speed required.

During the present period of reconversion there are many limiting factors to the Bureau's ability to go into full production. Shortages of material, equipment, and housing facilities are major considerations which retard a maximum construction program.

The Federal Government, in accordance with the President's directive of August 2, must not compete with private enterprise for scarce materials and labor. In this directive he also stated that only the most essential new public construction works should be undertaken, and any inflationary trends must be combatted.

Bureau Awards Contracts

Between VJ-day and July 1, 1946, when the Bureau was prepared to go into full production to get postwar construction and employment under way, it proved its ability to handle the large-scale public-works program with which it had been intrusted.

Here is a recapitulation of the volume of construction contracts awarded in the fiscal year just closed.

Period		*Total*
July to September 1945:		
July 1 to VJ-day 1945	$1, 614, 380	
VJ-day to Sept. 30, 1945	516, 914	
		$2, 131, 294
October to December 1945		2, 130, 516
January to March 1946		34, 385, 297
April to June 1946		70, 587, 400
Total, fiscal year 1946		109, 234, 507

From these figures it can be seen that only $1,614,380 of the $109,234,507 was awarded prior to VJ-day when general restrictions governing construction were lifted. When supplemental funds were made available on December 28, 1945, the velocity of the program was stepped up, resulting in over $34,000,000 worth of contracts being awarded between the first of January and the last of March 1946. Over $70,000,000 worth were awarded during April, May, and June 1946.

How was the money spent? Before VJ-day the total amount of $1,163,340 was awarded for beginning construction on the Friant-Kern Canal in the Central Valley project, California. This will be the longest irrigation canal in the world, 156 miles long, amounting in effect to a man-made river which will equalize the water supply for the lands of southern California.

During the next quarter, October through December 1945, contracts were awarded for beginning work on the Hudson Canal on the Tucumcari, N. Mex., project. About the same time, contracts were awarded for resuming work on additional canal lining sections for the 75-mile Conchas Canal on the same project. First delivery of water to the initial lands on Tucumcari was made early this year. Approximately 7,000 acres are now under irrigation and when the entire program is completed, 45,000 semiarid acres will be turned into productive lands.

The Coachella Canal of the All-American Canal system, located in southern California, also came in for some much-needed attention last year, and a contract was awarded for additional work on the All-American Canal at the same time.

$20,000,000 Dam Started

The new year ushered in the beginning of construction under a contract amounting to over 21 million dollars for work at Davis Dam, 35 miles west of Kingman, Ariz. This dam is the fourth great structure designed by the Bureau of Reclamation for regulating the flow of the Colorado River. In addition, the Davis Dam project will provide a power plant with an installed capacity of 225,000 kilowatts. Actual construction began officially on April 19, 1946 (see p. 125, June *Era*).

During the first quarter of the year contracts were also awarded for construction work on $4\frac{1}{2}$ miles of pipe line on the 41-mile Salt Lake Aqueduct, Provo River project. This concrete and steel pipe line will carry water from Deer Creek Reservoir to a point near Salt Lake City, Utah, and part of the construction was moved forward under WPB approval. The pipe has an inside diameter of 69 inches and a capacity of 150 second-feet. Water carried by the pipe line will supplement the water supply of Salt Lake City. Contractors received awards for continuing construction on the 38-mile Pilot Canal of the Riverton project in Wyoming; for beginning construction of earthwork and laterals for the Dodson Pump Canal on the Milk River project in Montana; for transformers at the Parker power plant located on the border of Arizona and California; for the Altus Canal and Altus laterals and sublaterals on the Altus project in Oklahoma; for continuing construction on the Friant-Kern Canal and the All-American Canal, as well as for the Government camp and utilities at Davis Dam.

Missouri Valley Work Started

In March 1946, contracts amounting to over a million dollars were awarded for beginning construction on the Rams Horn and Prospect Tunnels on the Colorado-Big Thompson project.

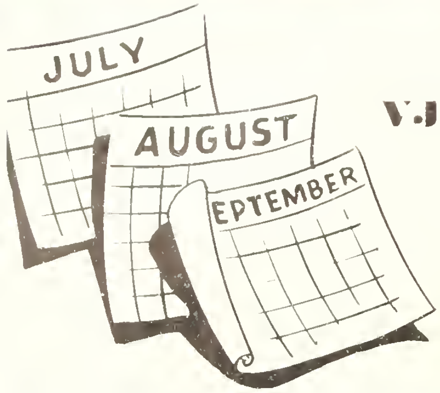
April, May, and June of 1946 saw a contract amounting to over 4 million dollars awarded for beginning construction on the Kortes Dam and power plant to be located on the North Platte River in Wyoming. This is the first project to be started by the Bureau of Reclamation under the authority contained in the Flood Control Act of 1944. This act approved the coordinated plan for the development of the Missouri Basin—which includes plans for the eventual construction of more than 100 dams—and gave the "go ahead" sign for the first steps in constructing 29 Bureau of Reclamation units.

In May 1946, contracts of over a million dollars were awarded for speeding ahead with the construction of pumps for the Grand Coulee pumping plant and for beginning construction on Granby Dam on the Colorado-Big Thompson project. A contract amounting to over $5\frac{3}{4}$ million dollars was awarded for this dam which will create a reservoir with a capacity of 482,-780 acre-feet. This dam will be used to store excess water of the Colorado River which is supplied by melting snow during the late spring and early summer. From the reservoir the water will be pumped to a height of approximately 130 feet to feed a canal leading to Shadow Mountain Lake in Colorado.

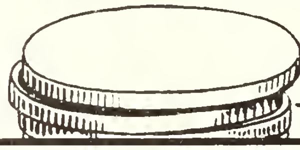
In June a tremendous boost was given to the construction program through awards for contracts on several outstanding projects. The scope of this one month's awards can be judged by citing a few of the major works involved.

(*Continued on p. 202*)

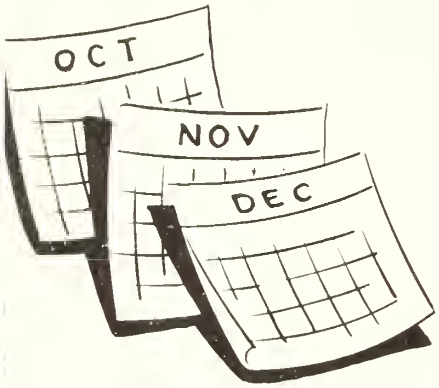
1945 When the Green Li



V-J Day

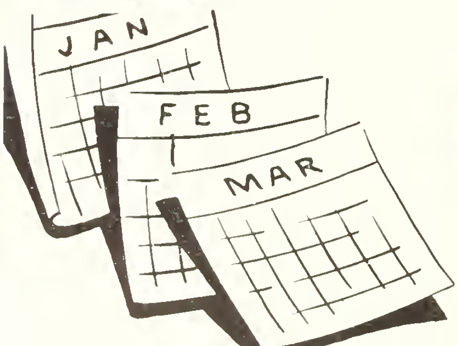


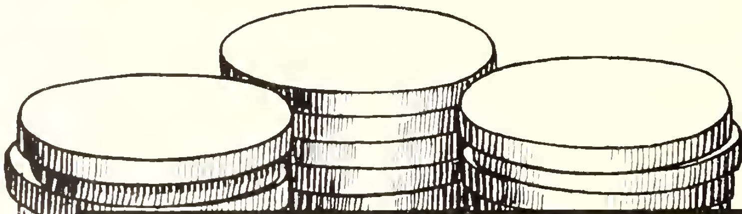
$2.000.000 worth of contracts awarded for beginning construction on Friant-Kern Canal and continuing work on existing projects.



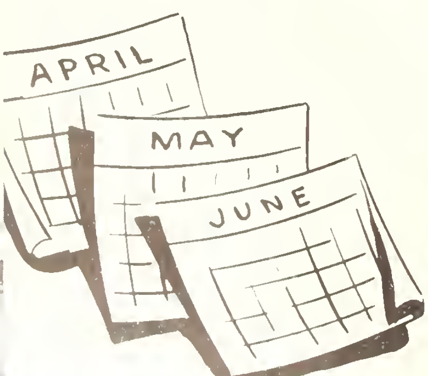
$2,000.000 worth of contracts awarded for beginning construction on Hudson Canal, continuing construction on Coachella and Conchas Canals, plus work on existing projects.

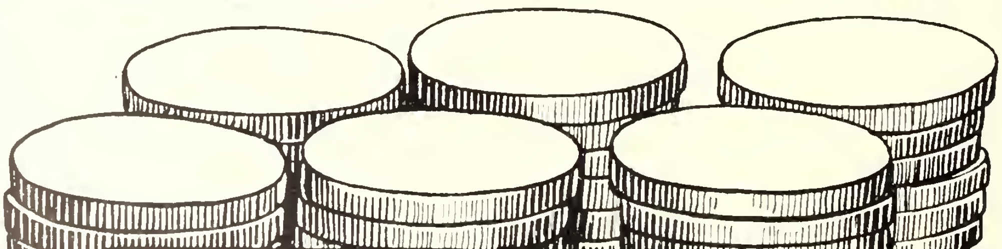
1946





$34.000.000 worth of contracts awarded for beginning construction on Davis Dam, Rams Horn and Prospect Tunnels on Colorado-Big Thompson project, and continuing work on existing projects.





$72.000.000 worth of contracts awarded for beginning construction on Kortes Dam and Power Plant, Cascade Dam, Angostura Dam, Horsetooth Reservoir, Columbia Basin Main and West Canals, and South Coulee Dam, and continuing work on existing projects.

RECLAMATION

ht Says "GO!"

HIFTS GEARS!!

WHEN THE GREEN LIGHT SAYS "GO!"

(*Continued from p. 199*)

Construction of ***Cascade Dam*** near the town of Boise, Idaho. Very little work was done during the war on this feature of the Boise project which will provide water to irrigate 25,000 acres of new land.

Construction of ***South Coulee Dam***, an earth-and-rock-fill structure on the Columbia Basin project. It is two miles long, and will form the south end of a 27-mile long reservoir in the Grand Coulee, which will make water available for irrigating the million-acre Columbia Basin project in south central Washington.

Construction of portions of the ***Main Canal and West Canal of the Columbia Basin project***. Construction details on these canals are covered in the article entitled "New Empire in the Northwest" in this issue.

Large Projects Pushed

First construction work on the ***Delta-Mendota Canal***, which is 120 miles long and the second largest irrigation canal in the Central Valley project. This canal will be used to convey water released from Shasta Reservoir, on the Sacramento River, to the San Joaquin Valley to replace San Joaquin water diverted at Friant Dam. The Friant-Kern and Madera Canals will take the San Joaquin water from Friant Dam to adjacent areas, and the Delta-Mendota Canal will replenish water to the lower valley by bringing it from the Sacramento Valley.

Construction of ***Angostura Dam***, located on the Cheyenne River about nine miles south of Hot Spring, S. Dak. This dam will form a reservoir with a capacity of 200,000 acre-feet and will include a distribution system for approximately 16,000 acres of arable land.

Horsetooth Reservoir on the eastern slope of the Continental Divide in Colorado will be formed by the construction of four earthfill dams and Satanka Dike and will serve as a reregulating reservoir with a capacity of 146,000 acre-feet. The capacity of this reservoir was increased so that it would serve the additional acreage formerly allotted to the Arkins Reservoir, plans for which have now been discarded. It will be about 6½ miles long and one-fourth to three-fourths of a mile wide. It is one of the features of the Colorado-Big Thompson project.

Thus it can be seen that, despite the obstacles of higher prices, shortages of material, and labor difficulties, the Bureau of Reclamation has forged ahead in its mammoth postwar construction program which has held out to the irrigation farmers of the West the promise of more fruitful lands in the future.

Besides the benefits which accrue to Reclamation farmers and their families, such large-scale construction activity gives an impetus to the reconversion program of the entire Nation. More than half of the money goes to localities outside Reclamation areas. Jobs are provided not only for veterans but for others whose skills were diverted to manufacturing methods of destructions and who now are putting their talents to use in creating the means toward an era of peace. For each 10 men hired at the site of a western Reclamation project, employment is provided for 16 men located at factories and processing plants in the East.

For instance, the effect of this construction program is felt at iron mines, coal mines, cotton mills, wire fabricating factories, to name a few; and by manufactures of road machinery and draglines, cranes, electrical equipment, generators, hydraulic turbines, special castings, high pressure gates and valves, and other facilities necessary to build, maintain, and operate the dams, dikes, canals, and other features of Reclamation projects. Transportation of these supplies and equipment to various construction sites has taken up some of the slack resulting from curtailed war production.

The proof of the Bureau's success in letting contracts and getting construction underway is now self-evident.

When the green light goes on again, the Bureau will be ready, as it has been before, to speed its program for developing the land and water resources of the West through irrigation and hydroelectric power.

Tule Lake Lands Opened to Veterans

The veteran settlement program of the Bureau of Reclamation is under way. Some 7,527 acres of lands in the Tule Lake Division of Klamath project will be opened to entry as of 2 p. m. September 15 according to public notice issued August 2.

World War II veterans whose applications were received between August 2 and 2 p. m. September 15 and if otherwise qualified will participate in a drawing to select successful applicants by lot.

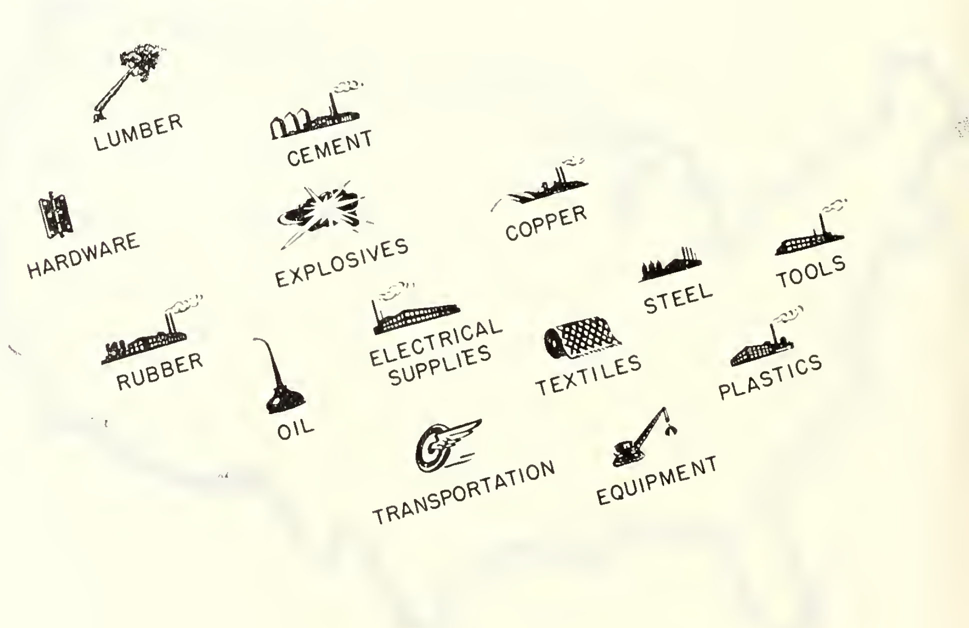
This is the first time that the principle of simultaneous filing has been applied to a modern public land opening. All applications received prior to the actual opening are accepted as of the same instant so that no time advantage accrues to any applicant.

If any farm units remain available after the drawing, applications received between 2 p. m. September 15 and December 15 will be considered in order of receipt.

Nonveterans may file entry for any units not awarded by the end of the preference period, December 15.

Before the year is out additional public lands, totaling 13,092 acres and providing 158 farm units on four projects located in the State of Washington, will be opened to homestead entry, Commissioner Straus said.

WHERE RECLAMATION MONEY IS SPENT



Benefits to the entire Nation

New Empire in the Northwest

Construction gets under way on the million-acre Columbia Basin project

by FRANK A. BANKS

*Supervising Engineer, Columbia Basin Project**

The Bureau of Reclamation has just started on the biggest peacetime construction job ever attempted in the Pacific Northwest—the development intended to add a million acres of irrigated land to the more than 4,000,000 acres already under irrigation in the Columbia River Basin. Work is underway on the Grand Coulee Dam pumping plant, the 16,000-second-foot feeder canal, near the Grand Coulee Dam, and the 13,200-second-foot main canal in the vicinity of Stratford, Wash. During the next few months, work will be undertaken on other important structures in the irrigation system.

At full development, when more than a million acres of land in south-central Washington are provided with a stable supply of water, a maximum total of about 4 million acre-feet will be drawn annually from the Columbia River at Grand Coulee Dam.

Lands Classified

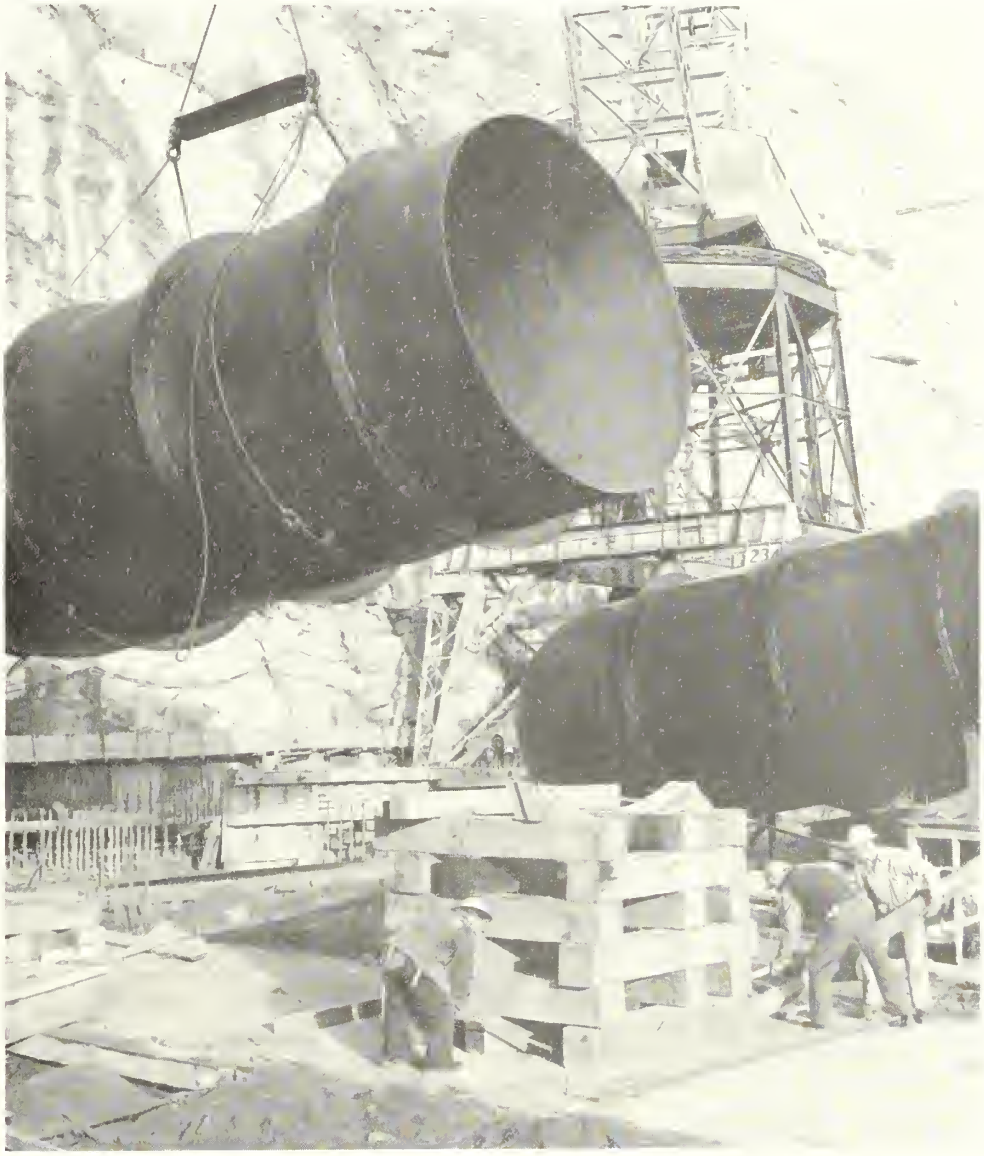
The need for irrigation water in the basin will vary greatly during different parts of the season, principally because of differences in crops, temperature, evaporation, and precipitation. On the basis of careful examination, four different classes of land have been designated as regards water duty. Estimates are that 42 percent of the lands to be irrigated will be water duty class A, requiring an annual allotment of 3.25 acre-feet; 24 percent are in water duty class B, requiring 3.50 acre-feet per year; about 22 percent are in class C, requiring 4 acre-feet, and slightly over 11 percent are class D, requiring 5 acre-feet.

In determining irrigable acreage in the project, no land was classified as arable unless the indications were that it could be successfully irrigated with not more than 5 acre-feet of water per acre per season. During land-classification tests, analyses were made of more than 8,000 soil samples.

On the basis of water duty investigations, it was decided that the distribution system be designed with capacity for delivery in 1 month of 23 percent of the annual requirements of 3,770,000 acre-feet; that sufficient additional capacity be provided in such structures as siphons, tunnels, and pipe lines to permit the delivery of 10 percent more water in canals designed to carry 100 cubic feet per second or less, and that such increased capacity in critical structures be graded downward, according to the size of the canal, to 5 percent for the largest canals.

Although there is ample water in the Columbia River to serve the project, none of it can, or will be, wasted. Farmers who use more water than they need, or an amount considered in excess of the estimated normal requirement, will pay increased charges. Any water user found to be making use of water in a way that is unreasonably wasteful and harmful to the project may have his supply reduced to an amount that, in the judgment of the Secretary of the Interior, will avoid further waste and harm.

Power generated at Grand Coulee Dam will be used to operate 65,000-horsepower motor-driven pumps which will provide water for the project distribution system, and the balance will be available for commercial and industrial use. The Grand Coulee Dam is virtually complete. Some additions are to be made, such as metal trim and the installation of permanent trashracks and other facilities, but most of the future work at Grand Coulee Dam will involve the powerhouses, the pumping plant, and maintenance of the spillway bucket.



SPECIAL DELIVERY of water to the world's largest pumps will be made through these super-sleeves.

World's Largest Facilities

The left powerhouse now has six 108,000-kilowatt units in place. Three more units—L 7, L–8, and L–9—are being manufactured. In addition, there are two station-service units of 10,000 kilowatts each. Orders are to be placed for the first three

*From an address before the 1946 summer meeting of the International Joint Commission, Columbia River Engineering Board, and the Columbia River Engineering Committee, July 8 and 9, 1946.

DIGGING A WATER BED. Earth movers at work on the Main Canal.

units in the right powerhouse, and the first of these is expected to be in operation by the summer of 1949.

Work which was interrupted by the war has been resumed on the pumping plant behind a 600-foot wing dam near the left abutment to Grand Coulee Dam. A $1,062,000 contract has been let for constructing the first six pumps. Each pump will have a capacity of 1,600 cubic feet per second under a total dynamic pumping head of 270 feet. Bids were scheduled to be opened on August 16 on the first six 65,000-horsepower electric motors, one for each pump. Bids also have been invited on 12-foot-diameter, steel discharge pipes leading from the pumping plant to the feeder canal.

The feeder canal, which is to be 1.6 miles long, leads to the equalizing reservoir in the nearby Grand Coulee. Construction work on the canal is seasonal and is being performed by "force account," or Government, employees. This feeder canal, to be lined with concrete, will have a bottom width of 50 feet and a water-surface width of 115 feet.

In the equalizing reservoir, to be formed by two earth-and-rock dams 27 miles apart, the active capacity will be about 700,000 acre-feet, obtainable with a draw-down of 30 feet from elevation 1,570.

The dam at the south, or lower end of the Grand Coulee, will be about 10,000 feet long. The north dam, at the upper end of the Coulee, near Grand Coulee Dam, will be about 1,360 feet long.

A $2,771,000 contract for the south dam has been let and work is expected to begin shortly.

The 13,200-second-foot main canal will begin at the south dam. Excavation of a short section of this canal is included in the contract for the south dam because such material will be needed in construction.

One and eight-tenths miles south of the south dam, the main canal will cross the Bacon Coulee in the 1,000-foot Bacon siphon, which will be 23 feet in diameter. The siphon connects with the 10,000-foot Bacon tunnel, also 23 feet in diameter, to be driven through solid rock. Later, as the project approaches full development, a companion siphon and a second tunnel will be provided.

The Bacon tunnel leads to Trail Lake, and at this point the main canal will follow a natural channel for 2.4 miles. Excavation will be resumed for the next 2.3 miles, to the head of Long Lake, where the water will drop 165 feet to the lake.

Construction has begun on the open channel of the main canal from the vicinity of Coulee City to Long Lake. Construction of the Bacon siphon and the Bacon tunnel will be under a contract for $3,494,000, which was granted recently.

In using Long Lake, approximately 5 miles of canal construction will be avoided. The use of this lake, however, will necessitate construction of a relatively small earth-and-rock dam—the Long Lake Dam—for which the Bureau of Reclamation opened bids on August 7.

Six and one-half miles of the main canal are now being built, from the site of the proposed Long Lake Dam, to the bifurcation works, about 6 miles east of Soap Lake. The successful bidder is performing this work under a $619,000 contract. Lining of the canal will be under a separate contract.

The west canal, to have a capacity of 5,200 second-feet, and the east low canal, designed for 4,500 second-feet, will originate at the bifurcation works.

Bids also have been called, and some opened, on several other structures in the irrigation system. Bids were scheduled August 15 on the 19,000-foot earth-and-rock Potholes Dam, near the center of the project. The Potholes Dam is designed to capture seepage and return flow from nearby irrigated lands, thus permitting reuse of water for irrigation and holding pumping costs at Grand Coulee Dam to a minimum. The active storage capacity of the Potholes Reservoir will be 350,000 acre-feet and will serve approximately 270,000 acres.

Several contracts are expected to be awarded soon in connection with the Pasco lateral system, about 12 miles northwest of the city of Pasco. This distribution system will serve approximately 5,300 acres and will draw its supply of water by pumping from the Columbia River at that point. The average lift will be 177 feet. It is planned to have this unit in operation in time for the 1947 irrigation season.

FEEDING water and material to the Feeder Canal, one of big jobs under way.

So new that you may not find it on your own travel map, Lake Roosevelt is being sought out by those "in the know."

Lake Roosevelt—Paradise Found

Lake Roosevelt, the West's longest lake and certainly one of the most beautiful, is so new that many cartographers haven't gotten around to putting it on travel maps. Created by Grand Coulee Dam while the world was at war, this 151-mile inland waterway in eastern Washington now is beckoning the traveler with its splendor of 600 miles of shore line, etched with massive basalt cliffs, wooded inlets, and timbered points. It is a giant in size, but still an infant in the world of recreation.

Because of its great length (it is the longest lake ever created by the Bureau of Reclamation), Lake Roosevelt has everything for the sightseer. Its deep waters range from light to dark green, to blue, to purple. It has small islands and large ones. It is a combination of Lake Placid, Crater Lake, the San Juans, and even a bit of the Chesapeake.

Perhaps its greatest appeal is its navigability. From Grand Coulee Dam small pleasure craft can be operated without danger 151 miles to the Canadian Border and for 177 miles farther up through the Arrow Lakes to Revelstoke, British Columbia, a city noted for its tourist attractions. The Coast Guard has installed navigation lights at strategic points.

As evidence of the lake's safety, a Bureau of Reclamation employee from Coulee Dam started from Revelstoke in his homemade kayak, and paddled the 328 miles to the dam in 8 days, without shipping a drop of water. When night approached, he simply ran his fragile craft to a sandy beach, rolled out his sleeping bag, prepared a snack, and then slumbered. He had no fear of suddenly rising water or heavy waves.

First to taste the pleasures of Lake Roosevelt were the Bureau of Reclamation employees at the town of Coulee Dam, who have established a yacht club, hold regattas, and take short trips up the lake. Few, however, have made the long trip to Revelstoke, because they find that their thirst for scenery and other enjoyment is easily satisfied only a short distance from the dam.

Lake Roosevelt has also become the gathering point for seaplanes. Several aircraft are stationed regularly at moorings near the

Perfect for motorboating.

Landmarks all over pleasure cruises feature Whitestone Rock.

Yacht Club, sightseeing trips are offered, and more than a score of local residents are taking flight training.

Sites for summer homes, camping spots by the score, bathing beaches, and dude ranches can be established along the lake. It is such a recent newcomer to the national scene that you can drive for miles without seeing a boat or canoe. Yet in the waters are rainbow and silver trout, and along its shores are pheasants and quail. The Bureau of Reclamation has provided a State-operated fish hatchery for stocking the lake.

Under sponsorship of the Bureau of Reclamation, a group of recreation experts recently completed an extensive survey of Lake Roosevelt's recreational possibilities. Its detailed report, prepared under the guidance of Claude E. Greider, Recreation Planner, National Park Service, recommends development of several sites for the public's benefit. They point out that good roads lead to the lake, and that it is less than a day's travel from such other attractions as Glacier and Mount Rainier National Parks, the Columbia River Gorge, and Mount Baker. And, as a matter of fact, Grand Coulee Dam, which ties with Mount Rainier as a tourist attraction, provides one of the pathways to this great lake.

At Grand Coulee Dam, Lake Roosevelt ends in a boisterous waterfall as it plunges over the crest for a 320-foot drop. Here the Columbia River displays its might for all to see, creating huge waves that dash against the banks, sending spray 50 and 60 feet into the air, and filling the sky with a thunderous roar. No man dares navigate the river directly below the falls. It would crush a boat into matchwood in seconds. Above the dam, however, pleasure craft rock quietly on the serene waters of the lake.

Enthusiasts believe Lake Roosevelt always will appeal to those who are tired of well-traveled routes and seek joy and relaxation in a primitive area untouched by billboards and hot dog stands.

Design for living—two boys and their dog, and the old swimming hole nearby

CAMERA FANS, PLEASE NOTE. Opportunities for good shots like this abound. O just look at the scenery, it's worth it.

THEY GOT WHAT THEY WANTED

There's a small piece of land north of the Spokane River and near the town of Coeur d'Alene which is today the pride of all north Idaho. It is the 3,500-acre Post Falls unit of the Rathdrum Prairie project to which the first official delivery of water was made this summer.

With water flowing down Bureau-of-Reclamation-built canals and laterals and onto dry farm lands, people of the area are more than ever convinced that their beautiful valley, long heralded as one of the finest recreational centers in the Northwest, soon will be a garden spot as well. For the 3,500-acre unit is part of a dream of local leaders to eventually irrigate 40,000 acres in the Coeur d'Alene region.

Between 800 and 1,000 farmers and citizens of nearby towns gathered to celebrate the coming of water to Post Falls lands, officially proclaimed a "milestone in the development of north Idaho." There were State and local dignitaries on hand, but it was essentially a community show.

Water was sent roaring into lines of the system when Louis B. Ackerman, Bureau construction engineer for the project, and Edgar H. Neal, chief, Division of Irrigation Operations for Region I, threw a switch in a powerhouse on the Spokane River, starting one of two 14,000-gallon-per-minute pumps. They were assisted by Kinsey Robinson, Spokane, president of the Washington Water Power Co.

Following this, the crowd was taken through the project where actual irrigation operations were demonstrated. Both sprinkler and gravity type systems were put into action for the benefit of the onlookers.

Spokane River waters flow onto the fields of Arthur L. Black, farmer of the Post Falls Unit of Rathdrum Prairie.

A community barbecue with heaping platters of choice top-grade beef, hot from the fire, and tables sagging from the weight of kettles brimful of potato salad, baked beans and other picnic requisites, completed the celebration. The barbecue was climaxed with speeches by local and State officials.

Speaking for the Bureau, Neal welcomed the Post Falls farmers into the family of water users. He told the people that they had every right to expect from the project a new and dependable source of wealth and prosperity which have been the result of irrigation elsewhere.

"I am sure that throughout the coming years the crops produced and the homes and communities created here will have a marked influence on the prosperity of the region. The Bureau of Reclamation is proud of its contribution in helping the people of the Northwest develop their region. We have assisted in transforming an unproductive wasteland into fertile farms which in 1945 produced crops valued at over $178,000,000," Neal said.

Neal was introduced by Burl C. Hagadone, Coeur d'Alene, president of the North Idaho Water Conservation Association and a longtime worker for the project. Hagadone outlined efforts which resulted in the undertaking and said that it was the first in what is hoped will be 40,000 irrigated acres in North Idaho.

Kinsey Robinson of the Washington Water Power Co. told of cooperation between Federal, State, and local groups which had made the project possible. He praised the Bureau of Reclamation for its work in the area and promised the full sup-

Ben Lalor, farmer; Mike Lalor, and E. G. Younger, Chamber of Commerce secretary at Coeur d'Alene, hear how crop-producing irrigation water is measured.

Five-year-old Leslea Banks helps Louis B. Ackerman, construction engineer, open the gates that sent water for thirsty acres spilling into the first lateral.

The standard gravity type irrigation system predominates on the project, but Conrad Schaefer and other farmers are also testing sprinklers.

Home from service in the armed forces, Mr. Banks makes hay on the project. His assistants are Leslea and eight-year-old Charel.

port of his organization to future undertakings.

"The Bureau of Reclamation has an outstanding record for cooperation with local peoples and assisting them to develop their resources. It is one of the finest records ever achieved by any Federal agency. I know that they will give you every consideration in planning and executing future developments in this area." Robinson said.

A special place in the program and in the records of the occasion was reserved for Ackerman, who has supervised construction of the Post Falls unit. Local leaders sent him on to a new position on the Columbia Basin project at Pasco with their thanks and a warm invitation to return and build additional units of the project when they are authorized.

For Lee Brugger, secretary-manager of the irrigation district, opening of the Post Falls unit meant a dream come true. Oldest person in point of residence in the district, Brugger has worked for the development for most of his life.

Others who spoke briefly included Carroll Dwyer, Portland, irrigation economist of the Soil Conservation Service, who outlined the place of the Post Falls unit in a coordinated plan for the Northwest's development, and James Ford, Spokane, secretary-manager of the Chamber of Commerce.

Between 125 and 150 families are expected to reside on the project under full development, many being part-time farmers. Included in this will be a number of veterans of this war who have already, or will shortly, establish homes in the area.

In place of an agriculture tied to one or two basic crops, local leaders expect a diversified farming program with a wide variety of produce. As in the nearby Spokane Valley, row and specialty crops are expected to do well on the Post Falls unit.

Fort Randall Started

Assistant Commissioner of Reclamation W. E. Warne represented Commissioner Straus at ground-breaking ceremonies for Fort Randall Dam July 30. The 75-million-dollar Fort Randall Dam and Reservoir on the Missouri main stem is a multiple-purpose authorized unit of the Missouri Basin comprehensive plan. It will be constructed by the Corps of Engineers of the War Department.

Freedom from one-crop economy is assured by the irrigation water that removes weather hazards from the worries of farmers on the Post Falls Unit. This field of beans, part of 13 acres put under irrigation this year by Mr. Black, is indicative of the new trend in the region's agriculture.

These sheep were herded from the high mountain slopes into the San Luis Valley for their winter grazing.

Wool Gathering Pays

Spring came to southern Colorado, and, for the residents of San Luis Valley its sweetest music was the soft bleating of lambs and the sprightly whir of sheep shearing equipment.

These sounds mean money in the pockets of residents of the Monte Vista territory, for the sheep industry ranks second in cash returns for that section of the State where the Bureau of Reclamation is conducting important investigations to supply irrigation water for 500,000 acres of valley land.

Herded down from the mountains in the fall, the flocks graze during the winter months on the lush valley grass, go through the lambing period, have their winter overcoats removed, and are driven back above the timber line for a summer vacation of lazy grazing on the high mountain slopes.

In the spring the sheep are moved off pasture into corrals for the lambing season. For the most part it's just a traditional gambol for the lambs; but sometimes it's a gamble for the owners when orphan lambs—or lambs whose mothers are unable to nurse them—require as careful handling as a newborn babe. But the youngsters take readily to the bottle, and soon become as sturdy as their more fortunate brothers and sisters.

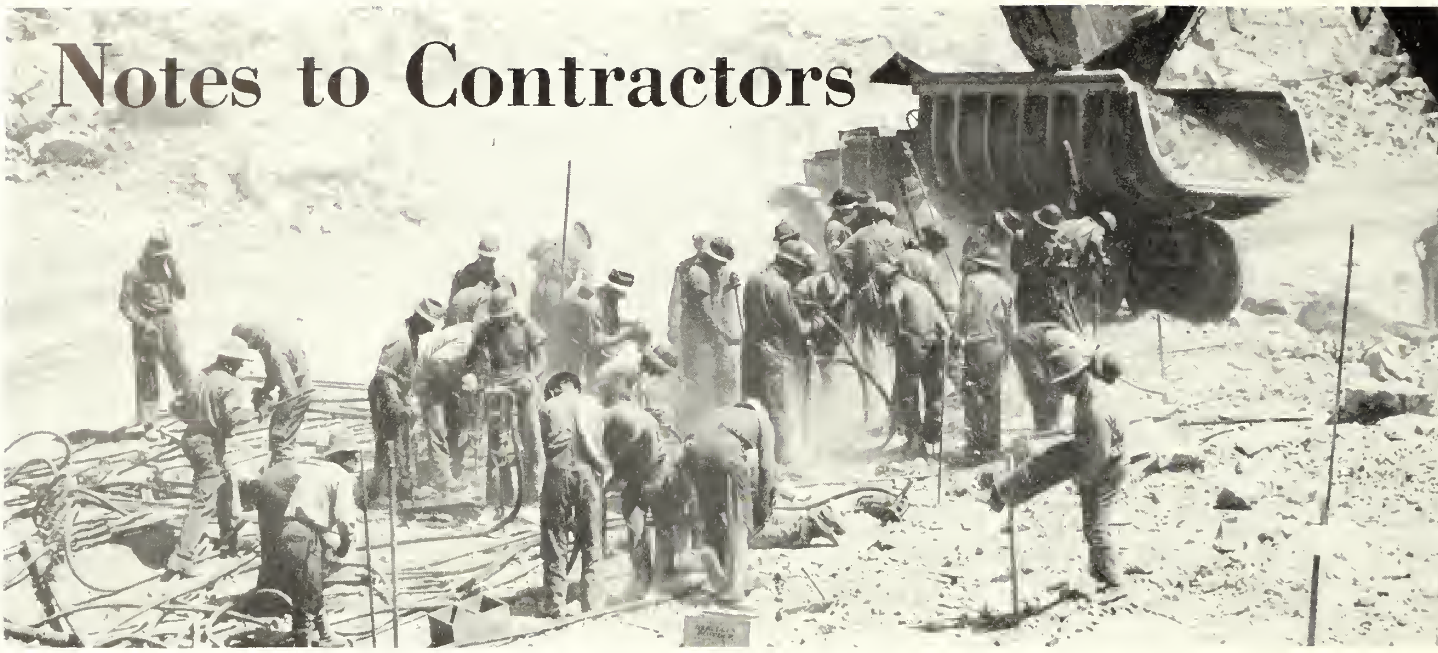
When the lambing season is over, migratory crews go to work on the shearing operations. The shearers are paid 26 cents a head for their work and, with deft movement, clip off the wool in an incredibly short time. Their assistants usually are paid a flat rate of \$6 per day. The sheep yield an average of about 12 pounds per head. The Rambouillet is a popular breed in the valley.

The lambing and shearing operations spread over the valley, with thousands of sheep bringing in the spring lamb crop and contributing their fleecy coats to strengthen the economy of the region.

A young lamb is inspected by J. W. Chavez (left), foreman, and W. S. Davis, part owner of a herd of sheep.

Hungry lambs miss their mothers but not their dinners. Bernice Davis (right) and Catherine Davis are feeding the orphans.

Notes to Contractors



Construction and Supply Contracts Authorized for Award during July ($50,000 or over)

Specification No.	Project, division and State	Date of award	Description of work or material	Contractor's name and address	Co am
1290	Yakima—Roza—Wash	July 1	Construction pumping plants for areas Nos. 1, 2, 3, 4, 8, 15, and 16.	Jose & Klug, Yakima, Wash.	$180
22,711A	Boise—Anderson Ranch—Idaho.	July 2	Cement	Oregon Portland Cement Co., Portland, Oreg.	117
1344	Hungry Horse—Mont.	July 10	Construction earthworks, structures and surfacing access road, Hungry Horse Dam, station 0+00 to 204+30.	S. Birch & Sons Construction Co., McLaughlin Inc., and C. and F. Trucking & Contracting Co., Great Falls, Mont.	479
1318	Buffalo Rapids—Second Division—Mont.	do	Construction Fallon pumping plant, relift plant canals, laterals and sublaterals.	Malcom G. Long, Billings, Mont	256
1968	Columbia Basin—Wash	July 11	Blasting caps for fiscal year 1947, Coulee Dam	Atlas Powder Co., Seattle, Wash	52
1322	Davis Dam—Ariz	July 12	Three 50 by 50 feet spillway regulating gates.	Consolidated Steel Corp., Los Angeles, Calif	162
1310	Columbia Basin—Wash	July 15	Preparation concrete aggregates Schedules 1 and 3 Odair deposit.	J. G. Shotwell, Albuquerque, N. Mex	172
1152	Central Valley—Kennett—Calif.	July 19	Construction Oroville-Sacramento transmission line	H. H. Walker, Inc., Los Angeles, Calif	281
R2-3	Region 2—Calif	do	Aerial mosaic maps and photographs	Fairchild Aerial Surveys, Inc	68
21,272A	Boise—Payette—Idaho	July 22	Cement	Oregon Portland Cement Co., Portland, Oreg.	89
A20,409D	Denver—Colo	do	Office equipment	Denver Blue Printing Co., Denver, Colo	114
1374	Altus—Okla	July 24	Construction earthwork and structures, Altus Canal, station 610+00 to 1147+37.	Stamey Construction Co., Hutchinson, Kans	337
1380	Provo River—Deer Creek—Utah.	do	Schedule 1—Construction of earthwork, pipe lines, structures, Jordan Narrows siphons, station 1664+2.89 to 1183+25.	Carl B. Warren, Pleasant Grove, Utah	162
1394	Missouri River Basin—Mont.	do	Schedules 1 and 2—Dismantling and moving buildings, constructing streets, water distribution and sewerage systems.	Landon Construction Co., Casper, Wyo	207
1341	Columbia Basin—Wash	July 30	Materials for steel warehouse to be erected at Grand Coulee Dam.	American Bridge Co., Denver, Colo	70
1215	Colorado—Big Thompson—Colo.	July 31	Schedule 1—And spare parts, electrical equipment	Allis-Chalmers Mfg. Co., Milwaukee, Wis	82

Construction and Supplies for Which Invitations for Bids Will Be Requested During September

Estimated date bids to be invited	Estimated bid opening date	Project, division and State	Description of work or materia
Sept. 1	Oct. 7	Boise—Idaho	Two 100-inch butterfly valves, Anderson Ranch Dam.
Do	do	Boise—Payette—Idaho	12 by 13.38 foot fixed wheel gate frame and anchorage, Cascade Dam.
Do	do	Central Valley—Delta—Calif	20 turn out gates for Delta-Mendota Canal, spec. 1183.
Do	do	Central Valley—Kennett—Calif	Miscellaneous installations handling equipment for 96 inch outlet gates, Shasta Dam.
Do	do	Colorado—Big Thompson—Colo	One 30-inch ring follower gate, Granby Dam.
Do	do	Columbia Basin—Wash	One 18-inch hollow jet valve for Potholes Dam.
Do	do	Davis Dam—Ariz	One 17.5 by 34.66 foot fixed wheel gate, metal work for penstock gate erection pit, Davis Da
Do	do	do	One trailer for Parker switchyard.
Do	do	Mancos—Colo	One 24-inch hollow jet valve for Jackson Gulch Dam.
Do	do	Missouri Basin—Lower Marias Unit—Mont	One 14-inch hollow jet valve for Tiber Dam.
Do	do	Provo River—Deer Creek—Utah	One 30-inch hollow jet valve for Jordon Narrows siphon.
Sept. 2	do	Boise—Payette—Idaho	Electrical supplies for "C" Line Canal pumping plant.
Do	do	do	Electrical supplies for Black Canyon power plant.
Do	do	Columbia Basin—Wash	Transformers, etc., for Pasco substation and switchyard.
Do	do	do	Additional station service equipment at Grand Coulee power plant, switch gear and switch
Sept. 3	Oct. 8	Boise—Idaho	Oil purifying equipment for Anderson Ranch power plant.
Do	do	Columbia Basin—Wash	Earthwork, canal lining, tunnel and structures, Potholes East Canal, station 24+39.5 to 436+00.
Do	do	Hungry Horse—Mont	12.47 kilovolt transmission line and electrical distribution system for Hungry Horse Gover Camp.
Do.	do	Rio Grande—N. Mex	Construction 115 kilovolt Alamogordo to Hollywood transmission line (Invitation issued; sp tion to be issued Sept. 3).
Sept. 5	Oct. 10	Boise—Payette—Idaho	Construction Black Canyon to "C" Line Canal pumping plant transmission line (Inv issued; specification to be issued Sept. 5).
Do	do	Minidoka—Gooding—Idaho	Earthwork and structures, lateral 21.3 and sublaterals.
Sept. 6	Oct. 11	Central Valley—Kennett—Calif	Interior doors and structural glass for Shasta power plant.
Do	do	Columbia Basin—Wash	Interior door for Grand Coulee power plant.
Do	do	do	Materials and construction, Ephrata office building.
Do	do	Shoshone—Heart Mountain—Wyo	Miscellaneous materials for construction of Heart Mountain power plant.

(Continued on page 211)

Construction and Supplies for Which Invitations for Bids Will Be Requested During September—Continued

Estimated date bids to be invited	Estimated bid opening date	Project, division and State	Description of work or material
Sept. 9	Oct. 14	Colorado—Big Thompson—Colo	Deepwell, turbine type pumping units for station drainage and unwatering systems, Granby pumping plant.
Sept. 10	Oct. 15	Yakima—Roza—Wash	Earthwork, pipelines and structures, discharge pipes for pumping plants 1 to 17, inclusive.
Do	do	Boulder Canyon—All-American Canal—Calif	Reinforcement steel, Coachella Canal, Station 5725 to station 6106-06.
Sept. 15	Oct. 21	do	Three radial gates and hoists for Coachella Canal.
Do	do	Central Valley—Kennett—Calif	One car puller and one 40-ton stationary gantry crane, Shasta Dam.
Do	do	Colorado—Big Thompson—Colo	One 30-inch hollow jet valve, Granby Dam.
Do	do	do	One 11-inch hollow jet valve, Granby Dam.
Do	do	do	7.25 by 9.5 bulkhead gate anchorage for Granby pumping plant.
Do	do	Missouri Basin—Paintrock Unit—Wyo	Two 24-inch hollow jet valves, Lake Solitude Dam.
Do	do	Provo-River—Deer Creek—Utah	One 18-inch hollow jet valve, Jordan Narrows siphon.
Sept. 16	do	Altus—Okla	Reinforcement steel, Altus Canal, station 610+00 to station 1147+37.
Do	do	do	Wrought iron plates, Altus Canal, station 610+00 to station 1147+37.
Do	do	Boise—Payette—Idaho	Doors, windows, louvers, for "C" Line Canal pumping plant.
Do	do	Central Valley—Delta—Calif	Transformers for outdoor switchgear for Clayton and Ygnacio Canal pumping plants.
Do	do	Minidoka—Gooding—Idaho	Three 2,000 kilovolt-ampere transformers for Rupert substation.
Do	do	Columbia Basin—Wash	Conduit, cable, etc., for 12,500 kilovolt-ampere switchyard tie circuit at Grand Coulee switchyard
Do	do	do	Structural steel superstructure for Pasco pumping plant.
Do	do	Klamath—Oreg	Pumps, motors and control for pumping plant "G," Coppeek Bay Area extension.
Do	do	Missouri Basin—Lower Marias Unit—Mont	Electric motordriven, deepwell turbine-type pump, 100 g. p. m. against 250' H. Tiber Dam Government Camp.
Do	do	Missouri Basin—Owl Creek Unit—Wyo	Motor controls for Lucerne and Lucerne relift pumping plants.
Do	do	Missouri Basin—Yellowstone River Pumping Unit—Mont	Construction of pumping plant and appurtenant structures, Savage Unit.
Do	do	Yakima—Roza—Wash	Motor control equipment for pumping plants, including substations and transformers.
Sept. 18	Oct. 23	Klamath-Tule Lake—Modoc Unit—Oreg	Conversion of motor control equipment for pumping plant "D."
Sept. 20	Oct. 25	Boulder Canyon—All-American Canal—Calif	Reinforcement steel, Coachella Canal station 6106+06 to station 6267+10.
Do	do	Boulder Canyon—All-American Canal—Calif	Lumber, Coachella Canal, station 6106+06 to station 6267+10.
Do	do	Columbia Basin—Wash	Reinforcement steel, Pasco pump laterals.
Do	do	do	Precast concrete pipe, Pasco pump laterals.
Do	do	do	Lumber, Pasco pump laterals.
Do	do	Missouri Basin—Missouri River Pumping Unit—N. Dak	Motors, control cable and miscellaneous electrical equipment for Square Butte, Wogansport and—Wogansport relift pumping plants.
Sept. 23	Oct. 28	Colorado-Big Thompson—Colo	Miscellaneous metal work for Estes and Marys Lake power plants.
Do	do	Columbia Basin—Wash	Conduit, fittings and cable for Pasco and Pasco relift pumping plants.
Do	do	do	Roofing steel for Grand Coulee machine shop.
Do	do	Missouri Basin—Canyon Ferry Unit—Mont	Turbines, governors and generators for Canyon Ferry power plant.
Do	do	Missouri Basin—Heart River Unit—N. Dak	Construction of housing, miscellaneous buildings and utilities for government camp.
Do	do	Missouri Basin—Kirwin Unit—Kans	Construction of earthfill, Kirwin Dam.
Do	do	Colorado-Big Thompson—Colo	Discharge valve operating mechanism for Granby pumping plant.
Do	do	Missouri Basin—Missouri River Pumping Unit—N. Dak	Construction of pumping plants and appurtenant structures, Wogansport unit.
Do	do	Missouri Basin—Yellowstone River Pumping Unit—Mont	Miscellaneous electrical material for Savage pumping plant.
Do	do	Shoshone—Heart Mountain—Wyo	Construction 69 kilovolt Heart Mountain to Garland transmission line.
Sept. 25	Oct. 30	Boulder Canyon—Nev. Ariz	Valves and piping of 24-inch sump underwatering jet pump installation, Boulder power plant.
Do	do	Columbia Basin—Wash	Pressure regulating and other miscellaneous valves for units L7 and L9, Grand Coulee power plant.
Sept. 30	Nov. 4	Rio Grande—N. Mex	Electrical equipment for Alamagordo substation, including reactors and disconnects.

President's Directive Limits Bureau Construction

To conserve scarce materials and labor for the most essential construction, as well as to balance the budget and accelerate reconversion by preventing competition between the Government and civilian industry, the President, on August 2, issued a directive limiting public construction by all Federal agencies. In applying this order to the Bureau of Reclamation, construction expenditures for the fiscal years of 1947 and 1948 were limited to $85,000,000 for each year and expenditures by other bureaus of the Department of the Interior were to be gauged proportionately.

In a letter to the Secretary of the Interior, the President stressed the critical needs for veterans' housing and hospitals. He specifically requested a moratorium of 60 days on all new public works contract awards to permit these two all-important projects to catch up with schedule. After that time he directed that proposed public works contracts be further screened to determine what would be continued.

As this issue of the *Reclamation Era* goes to press, many of the details of how this new policy will affect specific Reclamation projects are missing. At present the Bureau anticipates that no existing contracts will be cancelled. More information will be made available in the next issue of the *ERA*.

Our Back Cover

NIGHT MUST FALL, but construction continues on what will be the highest earthfill dam in the world, Anderson Ranch Dam, near Boise, Idaho, part of the Boise project. This structure, now more than 75 percent complete, will be 444 feet high.

Personnel and Project Directory

J. A. KRUG, SECRETARY OF THE INTERIOR

Commissioner's Office

Michael W. Straus, Commissioner — Kenneth Markwell, Assistant Commissioner — William E. Warne, Assistant Commissioner

Clifford E. Fix, Chief Counsel; T. W. Mermel, Acting Assistant to the Commissioner—Engineering; G. S. Ellsworth, Assistant to the Commissioner—Management; Barrow Lyons, Chief Information Officer; William F. Kubach, Director of Finance; Glenn D. Thompson, Chief Personnel Officer; Kenneth F. Vernon, Progress Control Officer; C. A. D. Young, Director of Supply

Branch Directors: John W. Dixon, Director, Branch of Project Planning; Walker R. Young, Chief Engineer and Director, Branch of Design and Construction (Denver); Harvey F. McPhail, Director, Branch of Power Utilization (Washington); Goodrich W. Lineweaver, Director, Branch of Operations and Maintenance

Regions (Space does not permit complete list of offices within the regions)

Regional offices	Field offices	Location	Official in charge: Name	Official in charge: Title
REGION 1—R. J. Newell, director, Boise, Idaho.	Central Snake (district).	Boise, Idaho	George N. Carter.	Acting district engineer.
	Anderson Ranch Dam.	Anderson Dam, Idaho.	Donald S. Walter	Construction engineer.
	Deschutes	Bend, Oreg	C. H. Spencer	do.
	Yakima	Yakima, Wash	D. E. Ball	Superintendent.
	Roza division	do	Harold W. Pease	Construction engineer.
	Columbia Basiu	Coulee Dam, Wash.	F. A. Banks	Supervising engineer.
	Ephrata office	Ephrata, Wash	H. A. Parker	Engineer.
	Project development.	do	W. W. Johnston.	Acting supervisor.
	Minidoka	Burley, Idaho	S. R. Marean	Superintendent.
	Palisades	Idaho Falls, Idaho.	I. Donald Jerman.	Project engineer.
	Hungry Horse	Kalispell, Mont	Paul A. Jones.	do.
	Umatilla	Pendleton, Oreg	C. L. Tice	Reservoir superintendent.
	Rathdrum Prairie	Cœur d'Alene, Idaho.	Louis B. Ackerman.	Construction engineer.
	Bitterroot	Hamilton, Mont.	T. R. Smith	do.
	Missoula Valley	do	do	do.
REGION 2—R. L. Boke, director, Sacramento, Calif.	Central Valley			
	Kennett division.	Redding, Calif	I. C. Harris	Acting construction engineer.
	Friant division	Friant, Calif	R. K. Durant	do.
	Delta division.	Antioch, Calif	O. G. Boden	Construction engineer.
	Klamath	Klamath Falls, Oreg.	E. L. Stephens	Superintendent.
	Orland	Orland, Calif	E. R. Asdell	do.
	Project planning	Santa Barbara, Calif.	J. H. Fertig	Engineer.
REGION 3—E. A. Moritz, director, Boulder City, Nev.	All-American Canal.	Yuma, Ariz	J. K. Rohrer	Acting construction engineer.
	Gila	do	do	do.
	Yuma	do	W. A. Boettcher.	Superintendent.
	Coachella Canal	Coachella, Calif.	C. S. Hale	Division engineer.
	Boulder Canyon	Boulder City, Nev.	C. P. Christensen.	Director of power.
	Davis Dam	Kingman, Ariz	H. F. Bahmeier.	Acting construction engineer.
	Parker Dam Power.	Parker Dam, Calif.	S. A. McWilliams.	Construction engineer.
	San Diego	Escondido, Calif	R. B. Ward	Engineer.
	Project planning	Phoenix, Ariz	V. E. Larson	Assistant regional planning engineer.
REGION 4—E. O. Larson, director, Salt Lake City 8, Utah.	Eden	Rock Springs, Wyo.	E. V. Hillius	Chief clerk.
	Grand Valley	Grand Junction,	T. L. Sundquist	Superintendent.
	Mancos	Mancos, Colo	A. W. Bainbridge.	Resident engineer.
	Newton	Logan, Utah	E. J. Wick	Engineer.
	Pine River	Bayfield, Colo.	S. F. Newman	Reservoir superintendent.
	Provo River	Provo, Utah	L. R. Dunkley.	Construction engineer.
	Scofield	Price, Utah	P. R. Neeley	do.
REGION 5—W. R. Nelson, director, Amarillo, Tex.	San Luis Valley.	Monte Vista, Colo.	D. M. Forester	Project engineer.
	Valley Gravity	McAllen, Tex.	C. P. Seger	Area planning engineer.
	Tucumcari	Tucumcari, N. Mex.	M. P. Starr	Acting construction engineer.
	Altus	Altus, Okla	H. E. Robbins	Construction engineer.
	Rio Grande	El Paso, Tex	L. B. Fiock	Project superintendent.
	Ysleta office	Ysleta, Tex	F. D. Postle	Division superintendent.
	Las Cruces	Las Cruces, N. Mex.	E. S. Mayfield	Do.
	Carlsbad	Carlsbad, N. Mex.	T. B. Thomas	Acting project superintendent.
REGION 6—H. D. Comstock, director, Billings, Mont.	Belle Fourche	Newell, S. Dak.	S. T. Larsen	Superintendent.
	Buffalo Rapids	Terry, Mont	W. L. McClure.	Acting construction engineer.
	Fort Peck	Fort Peck, Mont.	Allen Mattison	Resident engineer.
	Intake	Terry, Mont	W. L. McClure	Acting construction engineer.
	Milk River	Malta, Mont.	H. W. Genger	Superintendent.
	Rapid Valley	Rapid City, S. Dak.	H. V. Hubbell	Construction engineer.
	Riverton	Riverton, Wyo	D. L. Carmody.	Superintendent.
	Shoshone	Powell, Wyo	L. J. Windle	Do.
	Heart Mountain division.	Cody, Wyo	W. L. Kemp	Construction engineer.
	Sun River	Fairfield, Mont.	C. L. Bailey	Superintendent.
	Missouri River			
	Project development staff.	Billings, Mont	W. E. Rawlings.	Supervisor.
	Boysen Dam	Thermopolis, Wyo.	R. S. Lieurance.	Project engineer.
REGION 7—E. B. Debler, director, Denver, Colo.	Colorado-Big Thompson	Estes Park, Colo.	C. H. Howell.	Do.
	Mirage Flats.	Hemingford, Nebr.	D. J. Paul	Construction engineer.
	North Platte district.	Casper, Wyo.	I. J. Matthews	District engineer.
	Missouri Basin			
	Frenchman-Cambridge.	McCook, Nebr	H. E. Robinson.	Project engineer.
	Kortez (under North Platte district)	Casper, Wyo.	I. J. Matthews	District engineer.
	Project planuing	Grand Island, Nebr.	P. L. Harley	Engineer.
	do	Pueblo, Colo	B. F. Powell	Do.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official: Name	Operating official: Title	Secretary: Name	Secretary: Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamiltou, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	L. P. Jensen	Boise, Idaho.
Boise (Notus division)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	Ethan Allen	President	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	Superintendent.	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	A. M. Lanning	Austin, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Grand Junction, Colo.	D. G. Leslie	Superintendent.	C. J. McCormick	Grand Junction, Colo.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont.	A. J. Bowman	Mauager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Norval T. Kitchen	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott	do	J. F. Heyden	Do.

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Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users—Continued

Project	Organization	Office	Operating official: Name	Operating official: Title	Secretary: Name	Secretary: Address
Lower Yellowstone	Board of control	Sidney, Mont.	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont.	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do
	Harlem irrigation district	Harlem, Mont.	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont.	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Lake	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	do	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Philip Hiibel	Superintendent.	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	M. R. Cooley, Jr	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr.	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington, Wyo	Austin P. Russell	do	Mary E Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr.	Mark Iidings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	Arlie S. Campbell	do	William T. Davis	Brigham City, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash.	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz.	H. J. Lawson	Superintendent.	F. C. Henshaw	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Vivian Larsen	do	James W. Blain	Spring City, Utah
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Floyd Lucas	do	E. F. Andrews	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo F. Clark	do	F. A. Baker	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hansen	Manager	A R. Hansen	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg.	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	J. D. Corliss	do	J. D. Corliss	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellensburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	B. G. James	do	Pauline Osterhout	Sunnyside, Wash.

McBride Appointed to National Reclamation Staff

Don McBride, former chairman of the Oklahoma Planning and Resources Board, is the new secretary-manager of the National Reclamation Association. He succeeds F. O. Hagie, who resigned to become executive vice president of the Seattle, Wash., Chamber of Commerce.

McBride, who had been closely identified with Oklahoma State waterways, reclamation and irrigation and conservation work since 1935, submitted his resignation to Governor Robert S. Kerr, of Oklahoma, effective September 1.

The National Reclamation Association serves the 17 Western States. It is designed to foster and promote conservation and utilization of water resources and sponsor reclamation and irrigation of arid and semiarid land in the West.

McBride, a native of Nebraska, engaged in engineering work at Lincoln, following his study of engineering at the State University. He was first employed in 1926 at Carnegie, Okla., as resident engineer for a public works project. In 1935 he was employed as field engineer for the Oklahoma conservation commission, and worked his way up to office engineer, assistant chief engineer, and chief engineer. He was appointed chairman of the planning and resources board, April 1, 1945, by Governor Kerr.

Projects amounting to $324,000,000 were authorized in Oklahoma in the 11 years McBride was associated with the State's planning and resources board, and projects costing about a third of this total have been constructed or are in progress. McBride was also instrumental in getting authorization for initiating a half-million-dollar navigation and comprehensive development project for the Arkansas River.

Bashore to Study Colorado River

Former Commissioner of Reclamation Harry W. Bashore has been designated permanent chairman of the Upper Colorado River Basin Compact Commission.

Appointment of a Federal representative in the compact negotiations for division of the waters of the upper Colorado River was requested by Governors Hunt of Wyoming, Maw of Utah, Osborn of Arizona and Vivian of Colorado.

At the organization meeting at Salt Lake City July 31, an engineering survey to determine a basis for allocation of upper basin waters was authorized. An engineer from each of the five States concerned will sit on the engineering advisory committee to submit recommendations to the Commission's Santa Fe meeting September 17–18.

In addition to the permanent chairman, members of the Compact Commission are: Grover A. Giles, Utah, secretary; Ed Watson, Utah; Charles Carson, Ariz.; Clark Bishop, Wyo.; Thomas M. McClure, N. Mex.; and Clifford H. Stone, Colo.

NIGHT AT
ANDERSON RANCH DAM

Bureau of Reclamation Photo

OCTOBER 1946

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HARVEST ISSUE

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Featuring:

A Look At The Crops

THE *Reclamation* ERA

OUR FRONT COVER

"Anyone Can Do It!"

Twelve-year-old James Beery and his 10-year-old sister, Alice Marie, took over a sagebrush-covered plot and converted it into a miniature Columbia Basin project, winning top 4–H club honors for their home vegetable garden. They did it all on their own, with a little help in laying pipe from the pumping plant to the garden, proving what real reclamationists can do. They ripped through the sagebrush and rye grass with a small power plow, planted their crops, pumped water from the nearby Columbia River below Grand Coulee Dam, and carefully tended their corn, peas, beans, potatoes, and other vegetables. Despite their success the Beery children are modest. "Anyone can do it," says James. "This soil will grow nearly anything if you give it a chance. About all we did was add a little commercial fertilizer and keep it well watered and cultivated." This success story, in miniature, will be duplicated countless times on a larger scale when some million acres in the Columbia Basin project of south-central Washington are opened to settlers.

Reclamation ERA

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Contents

Credits

Maps by A. M. Smith and W. L. Lucas and art work by James D. Richardson, Georgie Petty, and Mary Edmonson, Washington D. C. Front cover photograph by H. Wayne Fuller, Region I. Back cover photograph by William F. Klepser, Washington, D. C.

Commissioner's Corner

By WILLIAM E. WARNE
Assistant Commissioner

For Reclamation Farmers Only

No one needs to tell you that there are a lot of headaches in the reconversion program. Manufacturers, distributors, contractors, and other businessmen are having their troubles, it is true, but so have the families on our Reclamation farms. During my trip to the West I saw for myself how you were meeting the problems of reconverting your lands from wartime to peacetime use.

During the war you farmed your lands intensively, often using marginal lands subject to erosion in order to meet the demands for food, more food and still more food. There were shortages of animal and commercial fertilizers, and at the same time you had to produce soil-depleting crops on a large scale to meet immediate wartime needs. And yet your crop production record is one to be proud of.

From what I saw out West it appears that Bureau of Reclamation project lands which were already under irrigation when the war began did not suffer any major permanent damage, mostly due to your eternal vigilance. As you return to balanced crop practices, the soil will gradually recover from the ravages of wartime-accelerated production.

There were heavy demands for food and fiber, and you were forced to abandon temporarily or to relax long-established soil-conserving practices. Cropping patterns grew lop-sided as seed production, truck crops, dry beans, and potatoes were stepped up. Row crops went in on steeper slopes than normal, resulting in loss of top-soil through erosion.

Cover crops and green manure crops essential to maintain fertility were largely omitted. It was difficult to get machinery and help. Livestock were kept in the feed lots for shorter periods and finished mainly on beet tops and other roughages instead of cereals, which were needed for human consumption.

Despite these handicaps, your crop production during the war reached record-breaking proportions. You produced 198,052,000 bushels of potatoes; 13,643,000 bushels of beans; 7,543,000 tons of sugar beets; 12,816,000 tons of alfalfa; 124,795,000 bushels of grains; 17,313,000 bushels of seed crops; 2,214,000 tons of forage crops; 174,883,000 bushels of vegetables; 2,403,000 tons of fruits and nuts; and 408,000 bales of cotton.

Some of this I knew before I left Washington, D. C. But when I saw the hay in the stacks, the crates spilling over with vegetables, the boxes bursting with fruit, I realized even more fully how reclamationists had really come through. Everywhere I went I saw the evidence of other harvests completed or to come—evidence of stepped-up production to meet world-wide needs. And yet it was also indicated that reclamation farmers were reconverting their lands to peacetime use. When I returned to my office in Washington, I was gratified to be able to report that I believe the farmers on reclamation projects realize the need for returning to more normal and preferable irrigation methods, and what's more, have already started on their own reconversion program. You are reaping a bountiful harvest, and at the same time are providing for the future welfare of your lands.

This issue of the Reclamation Era is dedicated to you, the reclamation farmers of the West, who met the challenges of wartime needs and are now meeting the challenges of postwar reconversion with gratifying results.

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For the benefit of our subscribers and others who would like to purchase individual copies of particular issues of the *Reclamation Era*, the following rates have been established:

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Letters to the Editor

(Forwarded to the ERA office)

August 15, 1946.

Dear Mr. Chapman:

Your letter of July 12, 1946, and the May issue of Reclamation Era awaited me on my return from South America.

May I congratulate the Department of Interior and the Bureau of Reclamation on the resumption of the publication of so important a journal, a complete file of which is a permanent part of our collections.

Sincerely yours,

Luther H. Evans,
Librarian of Congress.

The Honorable
Oscar L. Chapman
Under Secretary of the Interior, Washington 25, D. C.

(This came to the ERA office from a hard-working Bureau employee in charge of applications for land in the Klamath project. It throws a new light on the problem of the land-hungry veterans and what is rapidly becoming the "crowded West.")

August 20, 1946

I feel like Santa Claus caught short.

Eighty-six farms and a vast and aching land-hunger that 8,600 would just about satisfy—as of this afternoon. For they've been coming in at 150 a day, 8,000 now, and no signs of stopping. And our applications are almost entirely from California and the Far Western States. How many have you got back there in Washington?

I hope I will not be assigned to help review applications. I might have to deny some from people who write letters like the wife of a man now lying injured in a Navy hospital:

> . . . he will be out next month and I want to have all the information I can get. He is *so* anxious for one of those homesteads, as ranch life is all he knows.

Most of all, I'm pulling for the ex-Marine who wrote up from San Diego:

> . . . I am most deeply interested in securing a homestead . . . I have been a marine for 6½ years. Three years and 4 months of that time I was a prisoner of the Japanese. During those years I dreamt of the day that I could own my own land and feel its security . . . I am 25 years old, in good physical health and married to a perfect wife. We expect a child in February. I have the money needed. After my imprisonment I received a small sum of back pay, and we now have $2,000 in our account. I am quite sure that I can undertake this venture although, speaking the truth, I am not what you would call an expert farmer. The knowledge I have acquired in farming has come from my experience as a prisoner. I was detailed on the farm in the Philippines and in Japan. I have no love for the Japanese, but you will agree with me that they are good farmers! As you can see, I do have my heart set on homesteading, and I sincerely hope my letter will find an opening for us.

I hope we can build dams and canals fast enough so that this reasonable American dream of "my own land and the feeling of security it gives me" will soon be a little better than the 100 to 1 shot it now is.

Seeing Is Believing

Practice Makes Perfect on the Altus Demonstration Farm

Farmers on the Altus Reclamation project in southwestern Oklahoma, now under construction by the Bureau of Reclamation, and folks for miles around are seeing what happens to crops when you control the water applied to the land.

Closer to the East than any project constructed by the Bureau of Reclamation to date, the Altus project covers 52,700 acres. Although as early as 1902 progressive farmers and civic leaders recognized the need for irrigation in this semiarid region, it took the project's demonstration farm to prove the benefits of irrigation to many local people.

This establishment must not be confused with an experiment station. There are two experimental farms in the project area, both under the direction of the Oklahoma A. & M. (Agriculture and Mechanical Arts) College, but their work is separate from that of the Bureau's demonstration farm.

The demonstration farm plan is an innovation in the Bureau. It was conceived in region V, with headquarters at Amarillo, Tex., serving Oklahoma, Texas, most of New Mexico, and parts of Colorado and Kansas. Purchased by the Bureau in 1944, the 58-acre farm is a half mile below the project's reservoir. It is a miniature of the average farm in the project area. The operator faces problems identical with those that project farmers will experience when their lands receive irrigation water.

The mean annual rainfall in southwest Oklahoma, although sufficient to grow fairly good crops, is often poorly distributed. Droughts are frequent. Summers are long and hot. When moisture is adequate, crop yields are high. But July and August frequently bring blistering winds. Growing plants wither; yields are reduced greatly.

Under these conditions, the demonstration farm is proving the value of irrigation water to supplement natural rainfall. On this farm, future irrigation farmers observe the results of applying moisture at seeding time and at proper intervals during the growing season.

Seeing is believing and practice makes perfect. How to apply water to soil and growing crops, and what the effect of fertilizer is upon the land are vital points of knowledge that can be gained best by visual education and practice. That is the basic reason for the Altus Demonstration Farm.

Most of the project lands will receive first irrigation water in 1947 and 1948. Meanwhile, farmers are visiting the demonstration farm to study operations and check on methods employed by experienced irrigation men. Here they have an opportunity to observe approved irrigation practices and learn to avoid costly errors after their lands are under the ditch.

First crops were grown in 1945, and immediately proved the value of irrigation. The 1945 returns from cotton in the undeveloped project area averaged $40 an acre. The farm's cotton in 1945 brought $102 an acre. Dry-land maize averaged $16.40 an acre. On the demonstration farm the crop was worth $77 an acre. Wheat on nonirrigated lands averaged $21.21 per acre in value. In the same year, irrigated wheat brought a return of $48.40 per acre.

Mid-summer heat and drought prevented extensive corn production on dry land in southwest Oklahoma. However, based upon local prices for Golden Bantam sweet corn, the demonstration farm's yield was valued at $665 per acre. Spinach, another crop generally foreign to the project area, grew on the demonstration farm to the tune of $225 per acre, at prevailing prices.

This year, the farm is growing 100 varieties of corn, several varieties of grain sorghum, 14 varieties of cotton, and 8 kinds of pasture grasses. Later, when project farmers have their crops laid by, the Bureau will sponsor a field day, when everyone in the area will be urged to tour the farm and become better acquainted with its operations and aims.

A large measure of the credit for the demonstration farm goes to Governor Robert H. Kerr, of Oklahoma, members of the Oklahoma Planning and Resources Board, especially Don McBride, chairman (recently appointed secretary-manager of the National Reclamation Association), and the Lugert-Altus irrigation district. Efforts of Governor Kerr and Mr. McBride resulted in a State contribution of $4,500 for the farm operation in 1945. The Lugert-Altus irrigation district donated an equal amount on an annual basis to carry the operations through 1948.

Willard Smith, with a record of 40 years in the Bureau, is the directing spirit behind the farm. Smith, who began work with

the Bureau at Belle Fourche, S. Dak., in 1906 and later served as construction engineer on the Tule Lake unit of the Klamath project in Oregon, became chief of the operation and maintenance work at the Altus project in 1945.

Bryce Henderson, who was reared on a farm in the project area and served as a Navy pilot during the war, is the farm operator. He lives with his wife and baby in the Bureau's new and modern four-room demonstration farm home. With considerably less speed and much more caution than he used as a Navy air fighter, Henderson maneuvers his tractor around the farm to kill hostile weeds and cultivate the many different garden and field crops.

Records of water uses, plantings, fertilizers applied to soils, yields and all other operations are under the charge of Orland Lowry, an agronomist graduate of Oklahoma A. & M.

Oklahoma's State experiment stations, established this year, are approximately 8 miles south of the Bureau's demonstration farm. One station, comprising 10 acres, is in a "tight land" area of the project. Wheat, cotton, alfalfa, and many varieties of field crops are being grown on this place, and the records of these operations will be invaluable to project farmers. The other State station of 18 acres, in a sandy land area, is growing melons, tomatoes, and other vegetables.

Following completion of the Reclamation project, it is expected that much of the acreage now planted to winter wheat will be used to produce alfalfa, alfalfa seed, and feed for livestock. Cotton, one of the principal crops, is expected to continue as a major cash crop for some time. However, as the project farmers "find their way" with irrigation, greater diversification (with increased attention to dairying and specialty crops) is likely to wean the people away from a precarious cotton economy.

What the farmers do in the future, however, will be up to them. Neither the Bureau's demonstration farm nor the State experiment stations are designed to compel farmers to follow suit. The farms and the experiment stations are the pilot plants. They will point the safe, sure way. That is all!

Representative farmers, businessmen in the area, and Bureau economists believe the future will bring a gradual change in the agricultural economy of the project area. This will be accompanied by the appearance of wholesalers and new transportation facilities, deep freeze and cold storage lockers.

Future specialty growers, whose plantings may range from an acre up, will have overnight markets in Dallas, Fort Worth, Oklahoma City, Wichita Falls, Amarillo, Wichita, Kansas City, and Denver. It is generally believed that project produce can be put on the market at a time when it does not need to compete with other production centers. Farm labor supply will not be a problem.

With a year to go before the first 20,000 acres of land will be ready to receive water, a number of reputable concerns are completing plans to establish plants in the urban centers near the project.

An amazing development of maize

The heart of a farm is the home

Mrs. Mattye Mae Williams, secretary of the chamber of commerce in Altus, reports the Kraft Co. is among the new arrivals in her town. Altus, population 10,000, is the county seat of Jackson County. It is the principal town in the area and is 85 miles by highway from Wichita Falls, 157 miles from Oklahoma City, 160 miles from Amarillo, and approximately 200 miles from Fort Worth and Dallas.

Project Construction Engineer Howard E. Robbins is as boastful of the project's potentialities and the current operations of the demonstration farm as any successful, conservative Bureau engineer could be.

"The demonstration farm," said Robbins, "already has shown the advantage of irrigation in this pioneering locality. The increased production, ranging from 100 to 200 percent, is a matter of record."

Robbins declares the farm has been of great benefit to the Bureau, as well as to future irrigation farmers. "It has guided us to a determination of methods we must follow in soil and water utilization under local conditions," he said. "We have learned much to date, and I know the farmers will receive invaluable experiences prior to the time they begin using water."

"I am from Missouri—I have to be shown," is a familiar expression even beyond the borders of Missouri. Next time you hear it voiced, here is your answer:

Visit the Altus demonstration farm.

BUILDING A "DUCK"

How a weapon against a jungle of weeds was designed

by Engineer L. W. Mabbot*

From 1942 to 1946 maintenance of the All-American Canal was, through necessity, reduced to an absolute minimum. The control of weeds and brush along the canal being least essential, was neglected entirely.

As a result, trees, brush, and weeds all made a remarkable 4-year growth, and upon the resumption of regular maintenance the removal of the jungles along the banks of the canal presented a major problem.

A truck-mounted weed burner similar to those used by the Imperial irrigation district was designed, built, and placed in operation. However, in many places the canal banks are so high that the truck-mounted burner could only scorch the tops of the vegetation. Also, because of the deep dry sand, travel along portions of the canal banks is difficult, to say the least.

Somebody thought of employing a burner mounted on a floating platform which would use the canal itself as a roadway and have the additional advantage of directing the flame at the base of the weeds, allowing the fire to burn up the bank.

It was decided to use an Army model DUKW-2½-ton amphibious truck, better known as a "duck," because it could be used either on land or in the water; it could be moved from point to point under its own power without tearing up pavement; it could be moved at a speed comparable to the truck burner; and its special tire equipment enabled it to travel through the desert sand. One of the Army's surplus ducks was ordered and the design of the burner started.

In designing the unit the engineers had to see that it: (*a*) had an oil capacity sufficient to allow operation for at least a half a day without refueling; (*b*) provided access to propeller shaft, bilge pump, screens, and other equipment under the cargo space; (*c*) provided sufficient flexibility in burner boom adjustment to allow burning on any slope either from the water or on land; (*d*) be able to travel from point to point without taking too much time to dismantle the unit; (*e*) keep the weight down to allow safe freeboard. The accompanying pictures show the result.

All the burner equipment, including the pump and motor, is mounted on the 600 gallon tank. The tank in turn is supported by a 3- by 3-inch angle rail running along each side of the duck at cargo deck level. The rails are supported by brackets welded to the duck frame.

The tank is reinforced inside to carry the weight without sagging. Cable eyes are welded to it both fore and aft so that

*All American Canal, Imperial Division Office, Region III

THE DUCK—ready to travel on land or water

FLAME THROWERS—burning the All-American (Canal) jungle of weeds

it can be slid back and forth on the rails, using the vehicle's winch for power, thereby providing access to the mechanism below and also allowing the operators to better balance the duck in the water. The boom can be rotated both vertically and horizontally on its support. The burner feedline can be rotated by means of the handle welded to it just behind the boom support. This allows the angle of the burner to be adjusted from the operating position for any slope of bank.

The end 16 feet of the boom can be folded back when the unit is traveling. A short length of reinforced neoprene hose in the feedline at the joint allows this folding and still is stiff enough to allow the burners to be rotated by the feedline.

Oil is pumped from the tank to the six burner nozzles at a pressure of 400 pounds per square inch by a gear type pump (formerly the hoist pump on a dump truck) driven by a 6 horsepower gasoline motor. This pump assembly is mounted on a shelf at the front end of the tank.

The All-American Canal is broken up into a number of sections by check and drop structures. Ramps have been constructed to enable the duck to crawl into and out of each section under its own power. The underwater portions of the ramps are covered with crushed rock to provide better traction.

Results are better than anticipated. Although it at first appeared that six trips of the truck burner would be required to get rid of the vegetation, it is now believed that two trips with the duck will do.

Reclamation at the Crossroads

When the National Reclamation Association Meets, the Spotlight Shines on Water Resource Development

Reclamation is at the crossroads. Developing western land and water for irrigation and complementary hydroelectric power production presents many vital issues. The time for decision has arrived.

Recognizing the gravity of the situation, western leaders will meet at the National Reclamation Association Convention in Omaha, Nebr., October 9–11, to discuss these vital issues.

The 17 States represented in the Asociation are west of, or bisected by, the 97th meridian. Low rainfall in this area makes irrigation indispensable to agriculture. Veteran settlement, irrigation shortages, increasing population, and the question of hydroelectric power production as a financial aid to water resource development, are linked with the program that has stood the test of 44 years.

The program was on its way to the most rapid expansion in its history when construction was temporarily retarded by recent executive directives and orders. The limitation on construction was due to conditions beyond the Bureau's control, and it is ready to swing into top speed when given the "go" sign.

Under the projects authorized for construction, including the Missouri Basin development, the acreage to be served will be increased threefold and the number of farm homes on Reclamation irrigated land would be doubled. The power installations at Reclamation dams would be increased almost 300 percent.

To reclamation farmers, veterans, other prospective settlers, and people living in the reclamation area, basin-wide development means an assured water supply, more irrigated lands, the additional hydroelectric power to aid irrigation, a dependable supply of municipal water and agricultural products, flood control, and an orderly program for conservation of fish and wildlife. To the entire country it means a stabilized agricultural economy, with all its implications of increased consumer demand by the West—a ready market for manufactured goods and supplies from other sections of the Nation.

With this background, a "preview" to the conclave at Omaha's Fontenelle Hotel was held in Washington early in September with top officials of the asssociation conferring with Commissioner Straus and members of his staff.

At these preliminary sessions, the Reclamation program was reviewed, and the groundwork was laid for significant developments.

*At the Washington "Preliminaries"**

Among the problems which will probably be foremost in discussions by the Reclamationists at Omaha are:

1. *Construction Freeze.*—Effect of the limitation in Reclamation construction on such matters as veteran setttlement, other irrigation expansion and power extension.

2. *Power and Irrigation.*—Low cost hydroelectric power's contribution to irrigation. The infeasibility, in many areas of the arid West, of further irrigation development without financial assistance from low-cost power developments. Recognition of of the fact that irrigation is the primary function of Reclamation. Recognition also of the importance of power as a part of reclamation consistent with irrigation's prior call on the water supply.

3. *Repayment Contracts.*—Consideration of congressional committees' interest in the financial status of many existing Reclamation projects. Required overhauling of irrigation contracts and a realization that future appropriations for new projects may be gauged by the manner in which existing contracts are observed. Consideration of possible extension of irrigation repayment periods from 40 to 50 years, in view of the increased construction costs of many projects under construction and the inability of present water users in certain cases to meet current repayment charges.

4. *Acreage Limitation.*—Analysis of the basic requirements of Reclamation law to assure irrigation benefits to the largest number of people.

5. *Veteran Settlement.*—Ways and means to speed permanent settlement of qualified veterans on Reclamation projects.

6. *Nonreimbursable Funds.*—Prospective legislation for expending nonreimbursable funds for silt and salinity control as well as for recreation and fish and wildlife developments on Reclamation projects.

7. *Basin Developments.*—Differences between single-purpose projects and present-day multiple-purpose undertakings of river basin scope, and increased benefits derived from river basin developments that comprehend the maximum use of every drop of water that can be conserved and put to every practicable use for the development of the West.

Warner W. Gardner, Assistant Secretary of the Interior, and the Department's former solicitor, will represent the Secretary of the Interior, J. A. Krug. He will analyze reclamation's contribution to the national welfare, including the benefits to the individual farmers, and business interests, particularly the owners of family-sized farms and small industries.

Michael W. Straus, attending his first National Reclamation Convention in the role of Reclamation Commissioner, will address the convention on the theme, "Reclamation—Where Do We Go From Here?"

The tentative roster of guests appears to be one of the most distinguished and representative ever to attend an NRA convention, including, as it does, western Senators, Members of Congress, Governors and well-known proponents of reclamation and water resource development.

The Department of Agriculture will be represented by N. E. Dodd, Under Secretary. The Corps of Engineers of the War

(*Continued on page 236*)

**In the usual order: Assistant Commissioner Warne, and Commissioner Straus, Bureau of Reclamntion; R. W. Sawyer, President, National Reclamation Association; Branch of Operntion and Maintenance Director Lineweaver, Bureau of Reclamation; Don McBride, Secretary-Manager, and E. W. Rising, and C. H. Stone, N. R. A.; Branch of Power Utilization Director McPhail, and Acting Chief Counsel Will, Bureau of Reclamation.*

CORRALLING THE COLORADO

What Lies Ahead for the People of the Colorado Basin? Here Are the Plans for Realizing Its Potentialities.

PART II—EMPIRE BUILDER

by Oscar J. Buttehdahl

Former Chief, Press and Radio Section

Boulder Dam was just a beginning in man's conquest of the Colorado River. A magnificent beginning, to be sure. This mighty dam arching its back against the torrents in Black Canyon has tamed one of America's wildest rivers. With Parker and Imperial Dams as working partners, it opened a new era of economic development in the great Southwest.

Today, the song of the jack-hammer is again reechoing in the canyons of the Colorado. A fourth great barrier—Davis Dam—is rising on the main stream of the river 67 miles below Boulder, as the Bureau of Reclamation and the people of the Colorado Basin move forward on a program to completely master the river and make full use of its tremendous resources.

Harnessed by irrigation and hydroelectric projects, the river has already transformed a barren desert into highly productive farms and generated the power which made possible the industrial development of a vast area. But only a fraction of the river's strength has been mobilized. It will have an even bigger job to do in the future to meet the needs of a growing Nation. Millions of gallons of its precious water, now wasted, could provide irrigation for tens of thousands of acres of additional land. The river could generate huge additional quantities of electric energy for the establishment of new industries and for developing the Basin's vast store of natural resources.

The important role which the Colorado River could play in the building of a new agricultural and industrial empire in the Southwest and in the Upper Basin States is graphically told in a Departmental report completed this spring under the general supervision of the Bureau of Reclamation. It is now being reviewed by the governors of the seven Colorado Basin States (Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming) and will later be submitted to the President and Congress.

Quick Look at the River

While the report does not set forth or recommend one basic development plan as preferable to all others for the Colorado Basin, it does present an "inventory" of 134 potential projects from among which a selection could be made to insure maximum use of waters in the Colorado River system. To better understand what the impact of such further development of the Colorado would be upon the region and the Nation, let us take a quick look at the river itself and the land over which it holds dominion.

The drainage basin of the Colorado embraces all or parts of 7 States, an area equal to one-twelfth of the United States. The river itself is nearly 1,400 miles long, rising in the snow-capped peaks of the Rocky Mountains in Colorado and Wyoming. After tumbling through forest-clad mountain valleys it emerges to the barren mesa lands of Utah and Arizona where the force of its flow has cut gorges a mile deep, Grand Canyon being the most spectacular example. Below Lake Mead, the reservoir created by Boulder Dam which is located on the Arizona-Nevada border, it courses through broad alluvial valleys and empties into the Gulf of California in Mexico.

Its drainage basin, an area of 242,000 square miles, is 900 miles long, ranging in width from 300 miles in the north to 500 miles at its lower end. It is divided geographically into two parts—the Upper Basin made up of portions of Colorado, Wyoming, Utah, and New Mexico, the Lower Basin embracing all of Arizona and parts of California, Nevada, New Mexico, and Utah with the dividing line at Lee Ferry near the northern boundary of Arizona.

Variety in Views

This vast empire of the Colorado River varies in topography from rugged, forest-clad mountains with peaks at elevations up to 14,000 feet, to the flat desert with abrupt mesas, barren as far as the eye can see except for stunted growths of mesquite, cacti, and sagebrush. In climate it runs the gamut from the cold and snows of the north with a growing season of less than 90 days, to the heat of the desert with an annual rainfall of 3 inches but with a growing season of as many days as the year is long.

No other region in the United States, with the possible exception of central California,

is so utterly dependent upon the water supply of its rivers for maintaining its existing economy and upon the full development of those water resources for its future economic growth.

What the pattern of that future might be and what tremendous possibilities lie ahead for expanding the agricultural and industrial frontiers of this region are outlined in the comprehensive report.

If all the 134 potential irrigation and multiple-purpose projects listed in the report could be developed, here is what would be done:

A million and a half acres of new land, now largely unproductive, would be brought under irrigation, opening thousands of new farms to settlement by veterans and others.

More than a million acres of land now inadequately irrigated in the basin would receive additional supplies.

Harnessed to new power plants with an installed capacity of more than 3,500,000 kilowatts, the Colorado and its tributaries would step up the production of electric energy in the region by almost 20 billion kilowatt-hours annually—power for industry, for developing mineral, coal and oil resources, for farm electrification and other needs.

The Colorado River would become a great stairway of storage reservoirs, holding back the flood waters of melting snows in the spring for use as needed during the dry, hot summers. Its tributary streams would be similarly harnessed. The danger of floods would be negligible. Towns and cities would be provided with safe, dependable water supplies. Fish and wildlife resources would be protected and recreational areas would be developed to make the area more than ever the playground of America.

Complex Job Ahead

That, in brief, is the job which Reclamation engineers have cut out for the Colorado River. It is not a job that will be done overnight, or perhaps in the lifetime of many of us. It is a task fraught with many difficulties, involving problems of great complexity.

For example, the Bureau's report stresses throughout the fact that before any substantial start can be made on a coordinated basin-wide development program, the basin States must reach an agreement as to a division of Colorado River water among themselves. The area served by the Colorado system is so big and so deficient in rainfall that there just isn't enough water to provide for all the potential projects listed in the report, to take care of expansion in existing or authorized projects and to meet present and future requirements for export of water to adjacent basins.

So the States must reach an agreement on how the water is to be divided. Under the Colorado River compact of 1922 they have made an allocation of water as between the upper and lower basin. Still before the States, however, are the knotty questions of how much of the available water shall be allocated to the individual States, and secondly, a determination by the States of water to be allocated to projects within their boundaries.

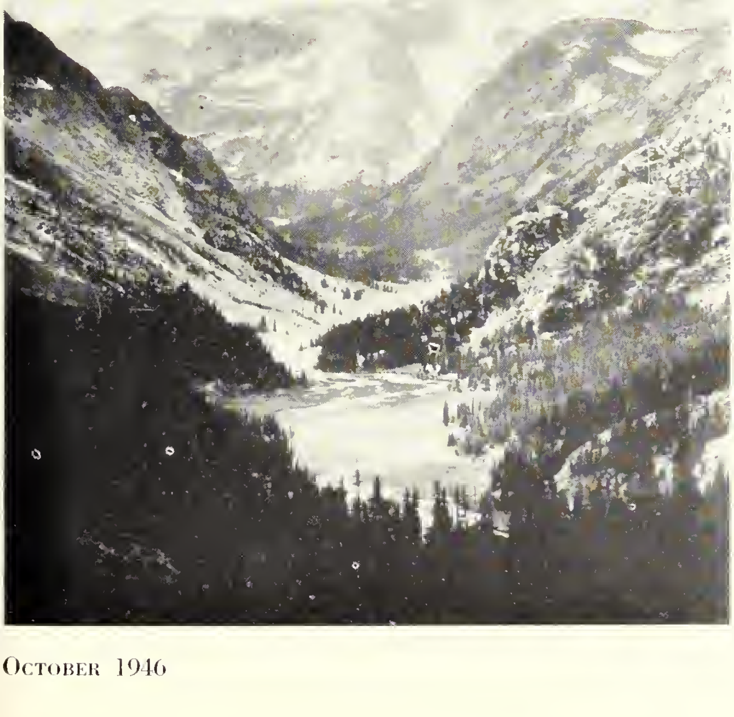
This does not necessarily mean that further projects cannot be undertaken in the basin until the States have agreed to a complete division of the water. Representatives of the Upper Basin States are already at work on the allocations problem. Until they make such allocations, officials of the Bureau have expressed the hope that "the States will recommend for construction, as the next stage of development, projects for which the stream flow depletions will assuredly fall within the ultimate allocation of Colorado River water which may be made to the individual States."

Not a Drop to Waste

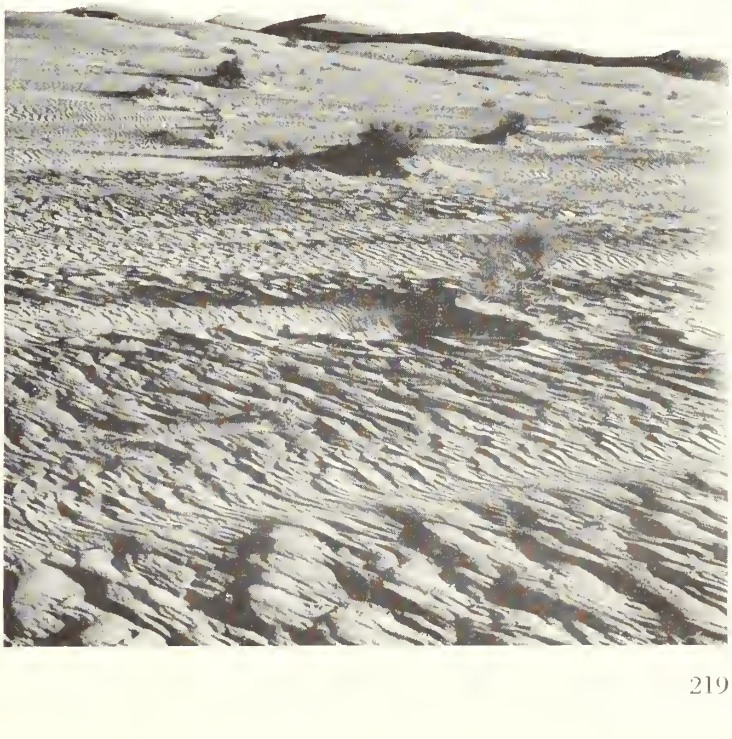
While the Colorado cannot provide all the water the basin needs, that fact in no way minimizes the river's importance as an empire builder. It is still the region's greatest and most potentially valuable natural resource. It still has a big job to do. The needs of a growing Nation demand that its resources be developed to the fullest possible extent—that not a drop of its precious water be wasted.

Put to work through additional multiple-purpose projects, the Colorado can do twice the job it is doing now in creating new wealth and opportunity. It can provide water for the irrigation of several thousand

From the snow-capped peaks of the Rocky Mountains . .



To the barren mesa-lands of Utah and Arizona . . .



new farms, and increase the production of farms already irrigated by providing an additional water supply. This would mean more food for American tables, foods needed for a more balanced and healthful diet.

Possibilities for industrial expansion in the basin are even more impressive. The key to such development is its fabulous power resources—the millions of kilowatt-hours of electric energy that could be generated by its rivers at low cost and sent out over transmission lines threading their way into the far reaches of the basin.

Bureau engineers say that even with plants at Boulder and Parker Dams turning out more than 6 billion kilowatt-hours a year, as they did in 1945, the Colorado River is still "loafing on the job" compared to what it could be doing in power production. Harnessed to additional hydroelectric plants, it could produce the energy for a multimillion dollar industrial expansion in the basin, providing jobs for additional thousands of workers and stepping up productive capacity to support an increased population of 2 million people.

Rich Mineral Resources

Low-cost power is only one of the basic ingredients for economic growth in the basin. Its mineral resources are among the richest and most varied in the world. Here lie buried billions of tons of bituminous and subbituminous coal—one-sixth of the world's known reserve. There are extensive deposits of copper, lead and zinc, of gold and silver, rare hydrocarbons, manganese (the world's largest manganese mine is located near Las Vegas, Nev., developed during the war to meet critical shortages) and stores of gypsum, cobalt, vanadium, molybdenum, radium, and limestone.

Here too is a storehouse of uranium from which atomic bombs are made and one of the basic elements for peacetime development of atomic energy. In Utah and Wyoming are great beds of phosphate rock which could become the basis of a thriving fertilizer industry. Great deposits of oil-bearing shale are found, a potential source of oil for the future. Natural gas is abundant. There are large deposits and a great variety of salts and clays which could be developed for commercial use.

Power from its rivers could not only be put to work in extracting and processing these buried resources, but it could energize railway locomotives to haul them to market and in other ways help to solve the basin's transportation problems. Lack of adequate transportation facilities has been one of the factors retarding agricultural and industrial development, particularly in the more mountainous upper basin. The bank building at Vernal, Utah, is an apt though exaggerated illustration of transportation difficulties of the past. It was built in 1919 with brick shipped in by parcel post from Salt Lake City. At that time, it cost $2.50 a hundred to ship brick by freight, whereas Uncle Sam's parcel post service delivered the brick at $1.05 for each hundred pounds.

With large blocks of hydroelectric power available at low cost, western railroads could be electrified. Smelters, refiners, and other processing plants could be established in areas closest to the source of raw materials. At the present time, for example, most of the copper mined in Arizona and Utah (70 percent of United States production) is shipped across the continent for electrolytic refining. Widespread use of hydropower would also help to conserve rapidly dwindling reserves of petroleum.

Adds to Nation's Funds

In the eyes of the Nation's taxpayers, there is another important consideration in developing the power resources of the Colorado River system. New Yorkers, Philadelphians, department store clerks in Atlanta, and farmers in Ohio look with some skepticism upon the idea of spending millions of dollars in far-away Arizona and Wyoming on dams, power plants, and irrigation systems—dollars which they paid into the Federal Treasury as taxes. Of course, they realize that they will benefit indirectly in many ways from such expenditures. But the best assurance the West can give them on that score is the fact that most of their investment will be returned—much of it with interest. Revenues from the sale of electricity at hydroplants will pay back the major portion of the costs of building not only the power projects but the dams and irrigation systems. Power sales also make it possible to undertake projects which, without repayment revenues from sale of power, would be uneconomical to build.

(*Continued on page 229*)

The key to industrial development

Another end product—irrigation

DATE PALMS GROW UP

And an elevator on wheels keeps pace with them, proving you don't have to climb a date palm tree.

by JOHN A. LEVERITT,

Davis Dam Project, Region III

A date palm creates a similar economic problem to that of the small boy who outgrows his pants before they are worn out—the taller the palms grow the more expensive it is to take care of them.

With the passing of each year the problem of harvesting the fruit from the rich date gardens of the Coachella Valley of southern California has become more acute. Many of the trees in the older gardens have grown as high as 40 feet. The date growers are meeting the problem with a device so modern that it would astound the Arabs of the Middle East who have been climbing the towering, rough trunks of the palms for centuries. It is a telescoping steel scaffold mounted on airplane wheels and pulled by a tractor.

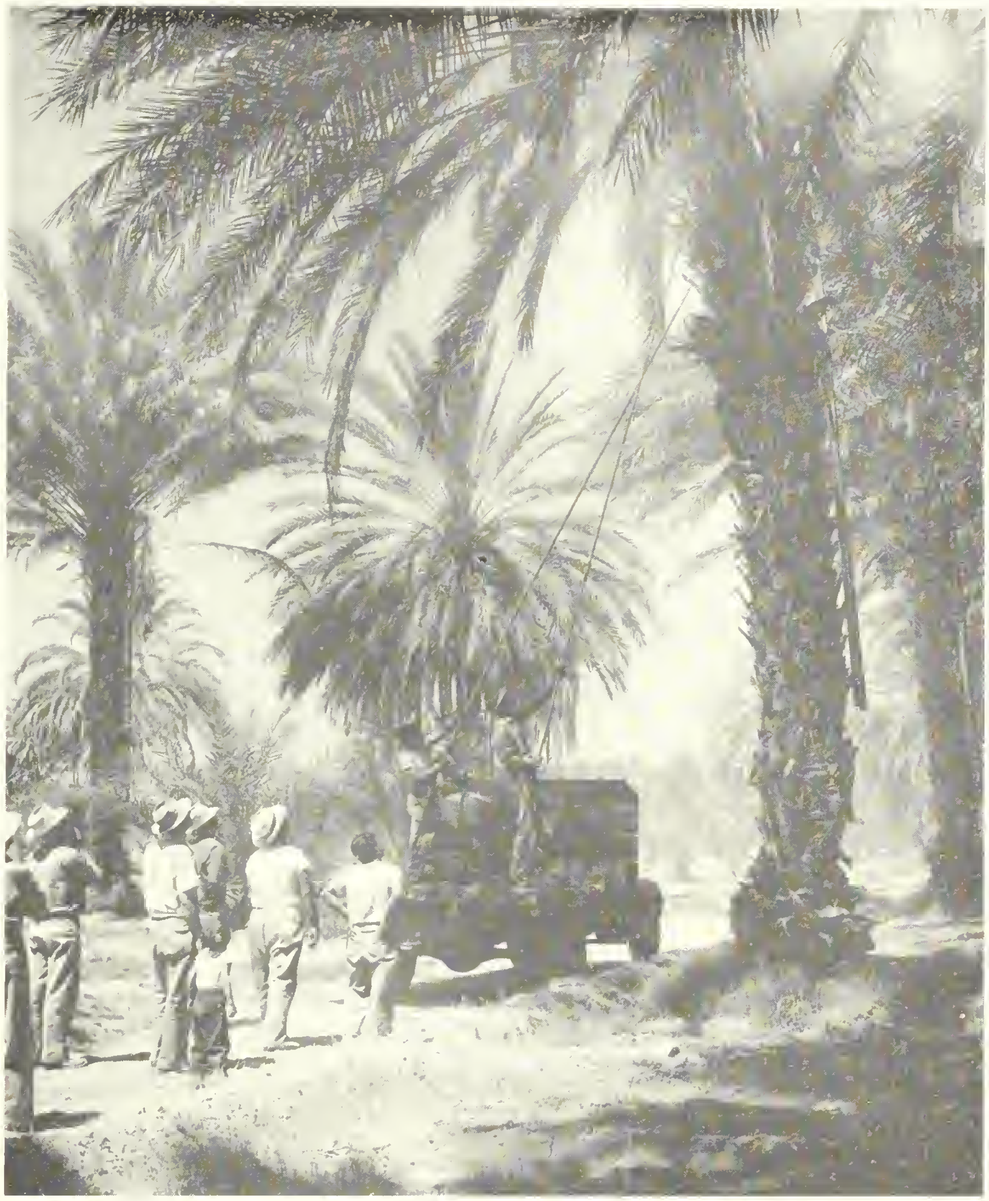
Coachella for Dates

The Coachella Valley, just north of the Salton Sea in Riverside County, is the principal date-growing area in this country, producing 95 percent of the domestic crop. Last year this area's date crop was valued at almost 2 million dollars. For many years the section has depended on pumping from underground sources for irrigation water, and the development of the area has been limited by the amount of underground storage.

The Bureau of Reclamation is now constructing the Coachella Main Canal, a branch of the All-American Canal, which will provide supplemental water for the acreage now irrigated, and permit an expansion to 75,000 acres.

Date growing in the valley began about 25 years ago, and the gardens which were planted during the early part of the development are the ones which are creating the problem. After the trees are over 30 feet high the care during growth of the fruit and the harvesting becomes too expensive by old methods.

If it were necessary to climb the trees only once to pick the fruit, the cost would not be too serious a factor. However, the date growers of the valley have evolved methods of date culture which necessitate work in the trees several times during the year. These new methods produce from three to four times as much fruit from each tree.



DATE DUSTING — This gasoline driven motor pump is used to dust date bunches with "Thiomate 19" to prevent fungus.

In February and March while the palms are blossoming they must be hand-pollinated. The microspores from the male trees are transferred to the female trees by laborers to assure a bountiful crop.

In June the bunches of young fruit are tied down so that they will not swing in the wind hitting the fronds and bruising the fruit. While the fruit is still small, many of the growers thin the bunches out so that the remaining dates will grow larger.

Protection Program

During July and August the laborers go through the gardens trimming the dead fronds from the trees and spraying the fruit with sulphur powder for protection against the date mite. In August the fruit is covered by paper bags to keep moisture from it. In addition to the bags, some growers place wire spreaders in the bunches to keep the dates apart as an additional protection against spoilage due to moisture. When green enough, the moisture does not damage the dates, but as they mature they are very susceptible to a fungus growth.

From August 15 to September 15 some of the growers dust the fruit with "Thiomate 19," a combination of sulphur and fermate, as a further protection against fungus growth. In some years the loss from fungus has been very high. As a result of this, Dr. Donald E. Bliss, noted horticulturist and expert on date culture, has developed the "Thiomate 19" method of protection.

All this work in the gardens means that men must be in the trees practically the year around. In the past, growers have permanently attached ladders to each tree. This costs in the neighborhood of $5,000 for

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each 10 acres. In addition, it is difficult to get labor for this arduous work when other work is plentiful.

Several years ago Bud Swindler, who owns an older date garden in the valley, built the first scaffold and called it a "date worker." Swindler's device was constructed of wood and was not flexible enough in that it could not be adjusted for trees of different height. Also, its base was too narrow and it tipped over too easily.

Swindler's idea was sound, however, and he has now developed a date worker which is adaptable for trees from 20 to 47 feet high. Eight men can now work four trees at one time and many man-hours are saved since the workers do not have to climb up and down the ladders.

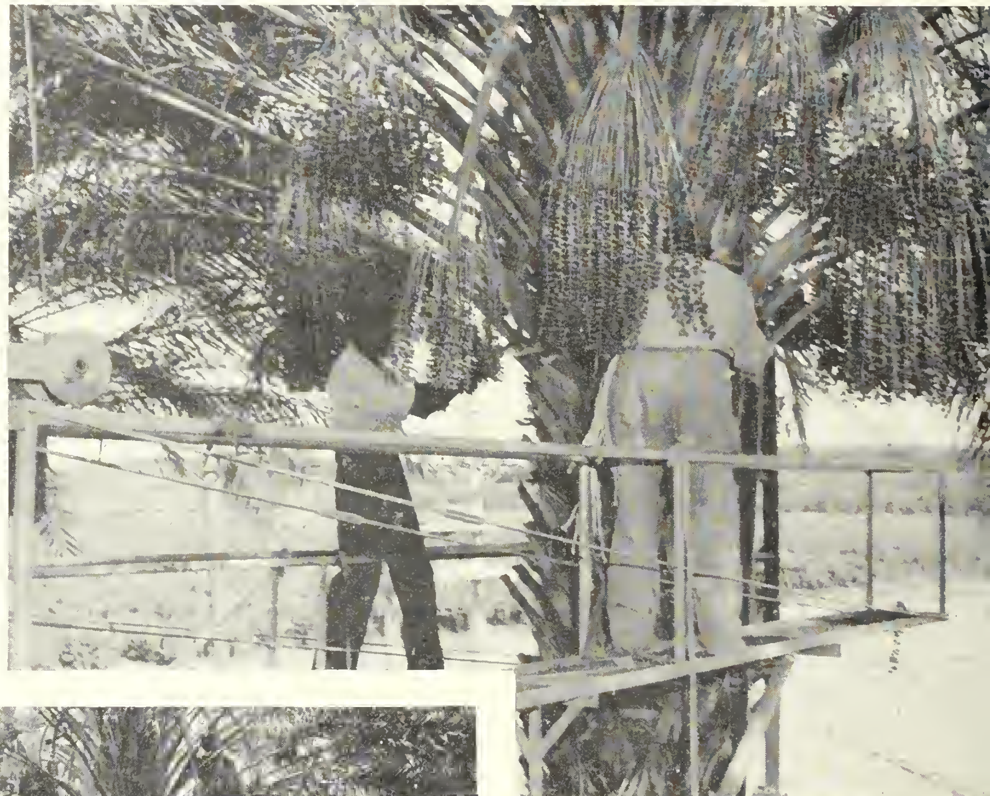
Streamlined Picking

The date workers are built on a solid base with airplane wheels far enough apart to give stability. The scaffold is constructed of angle iron and pipe welded together with steel mesh for the platforms. The height of the scaffold is adjusted by hand-operated winches.

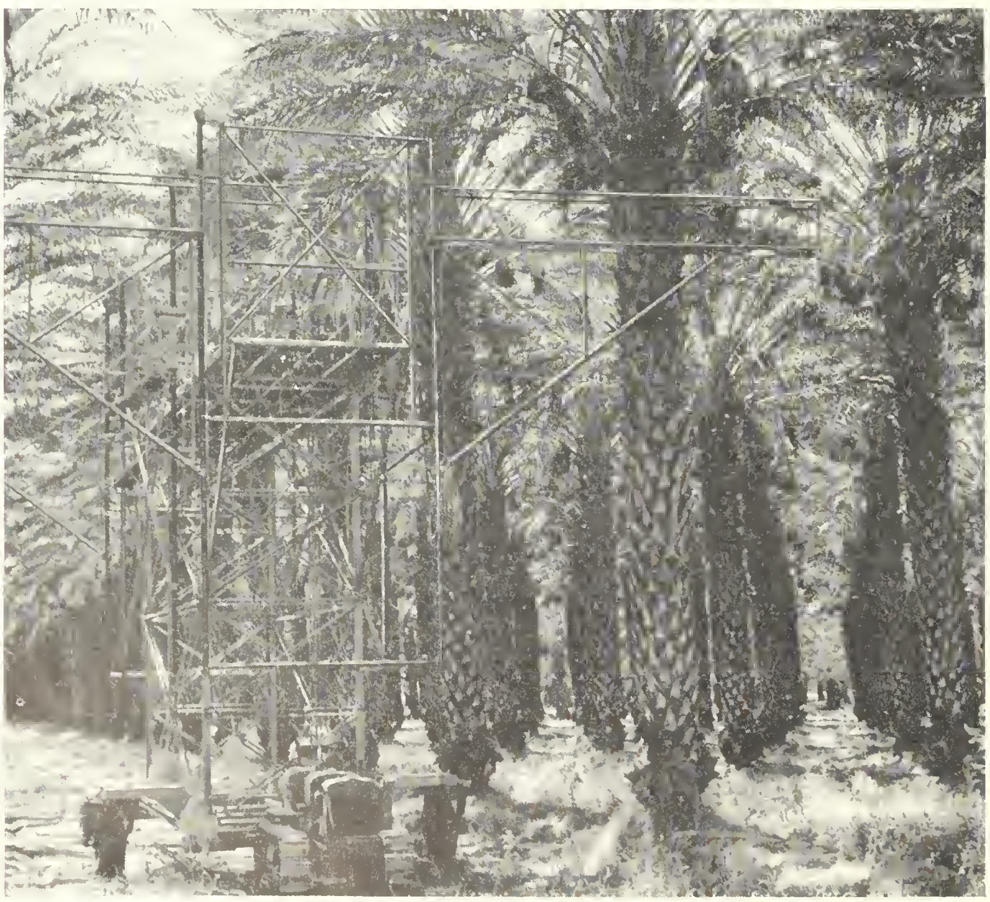
Two outrigger scaffolds extend from near each corner of the main tower so the workmen may easily reach the trees. These outriggers have independent controls for adjustment vertically and they swing freely in an arc.

The date workers can be constructed for a maximum of $5,000, and weigh about six tons. Each machine can adequately take care of 35 acres, which makes them economical as compared with the ladders costing $5,000 for 10 acres.

In addition to the saving in initial cost, the date workers save a tremendous amount in labor cost. The laborers can accomplish so much more when they do not have to return to the ground to move from tree to tree. While working from the outrigger scaffolds the men can stand erect most of the time instead of hanging onto the trees. This, of course, makes the work move faster while they are actually working on the fruit.

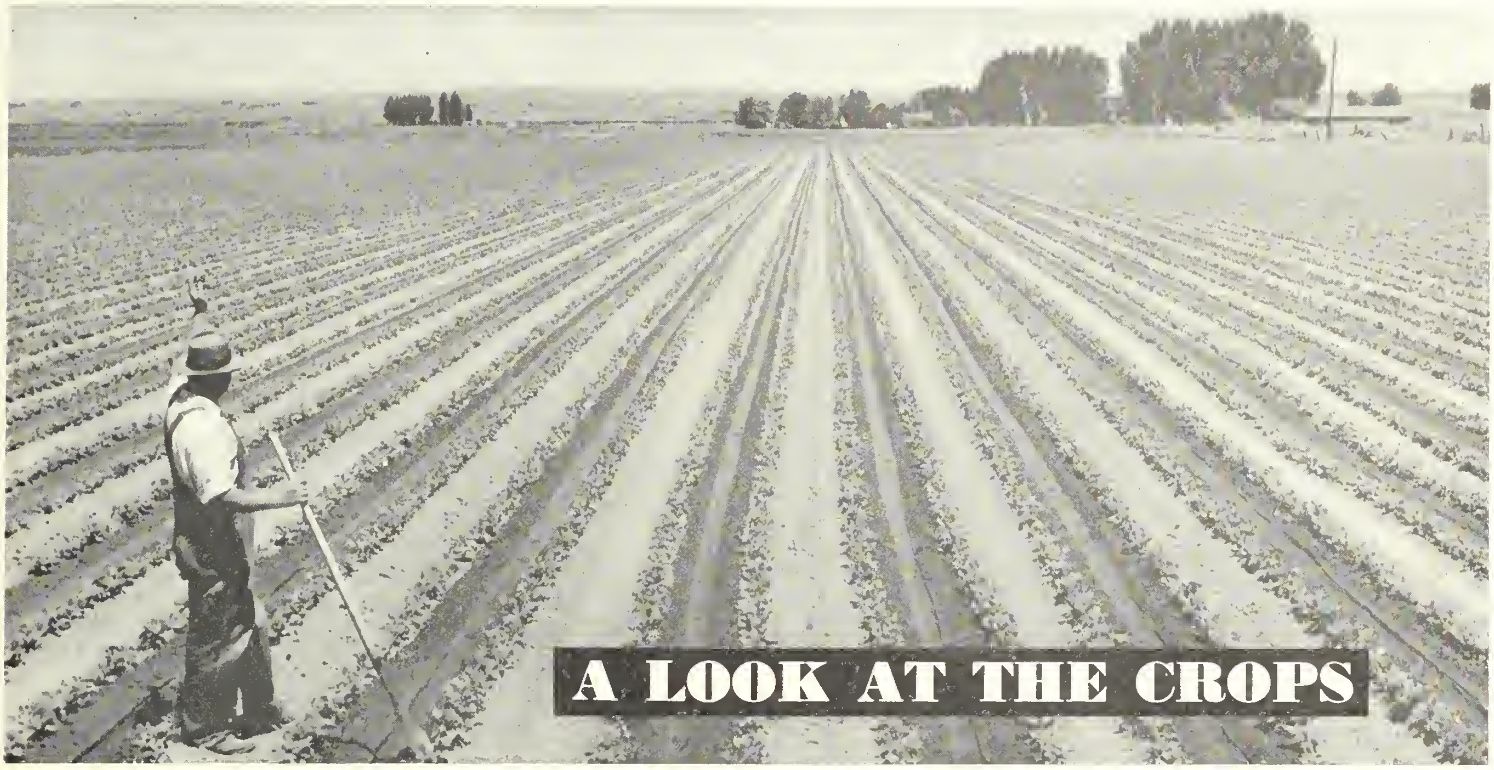


From a workbench in the sky date pickers safely and quickly gather the crop.



GOING UP? With the aid of the new telescoping scaffold, date pickers in Coachella Valley operate at any level.

Pickers roll along with the aid of airplane wheels like this one.



Reclamation farmers build up an impressive crop production record

by GLADYS L. WHITNEY,

Division of Economics and Statistics, Branch of Operation and Maintenance

When harvest time comes round farmers traditionally lean back in their chairs, heave a sigh combined of weariness and relief, and begin to take stock of what they have accomplished. The results of such stock taking have been far from discouraging to reclamation farmers—particularly during the past 4 years—when, along with other farmers in the country they produced record-breaking crops. In 1945, alone, Reclamation farmers had 4,195,732 acres under cultivation and produced a total of 11,814,337 tons of food and forage crops. These crops had a total gross value of $435,184,395, or an average of $103.72 per acre.

To help meet world demands, more than 5,000,000 tons of grains, hay, and feed crops were produced. Almost 117,000,000 bushels of vegetables, including beans and potatoes, were added to the Nation's supply from these projects. Of the 900,000 tons of fruit produced in 1945, one-third consisted of apples. An important crop in western agriculture—the sugar beet—was produced in these areas to a total of more than 2,300,000 tons. That was 26 percent of the total of 8,638,000 tons of sugar beets produced in the United States as a whole.

Federal irrigation projects are important to the livestock industry throughout the 17 Western States. The reliable source of feed created by these projects aids in developing and maintaining an intensive dairy industry, and tends to stabilize the production of cattle pastured on the range and fed within irrigated areas or adjoining lands. Of the total net area in cultivation in 1945 on the regular Federal irrigation projects 24.9 percent was in alfalfa and 3,588,000 tons of alfalfa hay were produced. An additional 21 percent of the total net area of all Bureau of Reclamation project lands in cultivation was devoted to the production of other hay and forage crops and irrigated pastures.

Something Special in Crops

Total crop production figures do not tell the whole story of Reclamation farmers and their achievements. Variety, often called the spice of life, abounds in the records of unusual crops produced. As the Reclamation area stretches from southwestern Arizona to northern Montana, crops range from semitropical products to hardy crops that can be matured in a short growing season—from those that can be raised near sea level to those that thrive at high elevations.

Among specialty crops are guar seed, pomegranates, coriander, artemesia, mint oil, and fenugreek, garlic, hemp, and sage. Most of these are planted year after year on certain projects where soil and climatic conditions are particularly favorable.

As an example of the variety of crops grown in the Southwest during 1945 there were 25,900 acres of green lettuce and 14,800 acres of cantaloupe vines from the Yuma and Salt River projects in Arizona. As a result there were 4,748,100 crates of lettuce and 1,856,100 crates of cantaloupes made available for the family table. Seventeen thousand acres were planted to flax, 13,000 acres in citrus fruit, 3,600 acres in carrots, 1,100 acres of pecan trees, and 400 acres of date palms on these two projects. In the nearby Imperial Valley, now receiving its water supply through the All-American Canal, even larger quantities of fruits and vegetables were produced. In this valley alone, 72,500 acres were planted in vegetables during 1945.

The Orland project in the Sacramento Valley of California produced such specialties as olives, small fruits, and nuts. Almond trees cover 1,900 acres on this project and in 1945 more than 1,000,000 pounds of almonds were harvested.

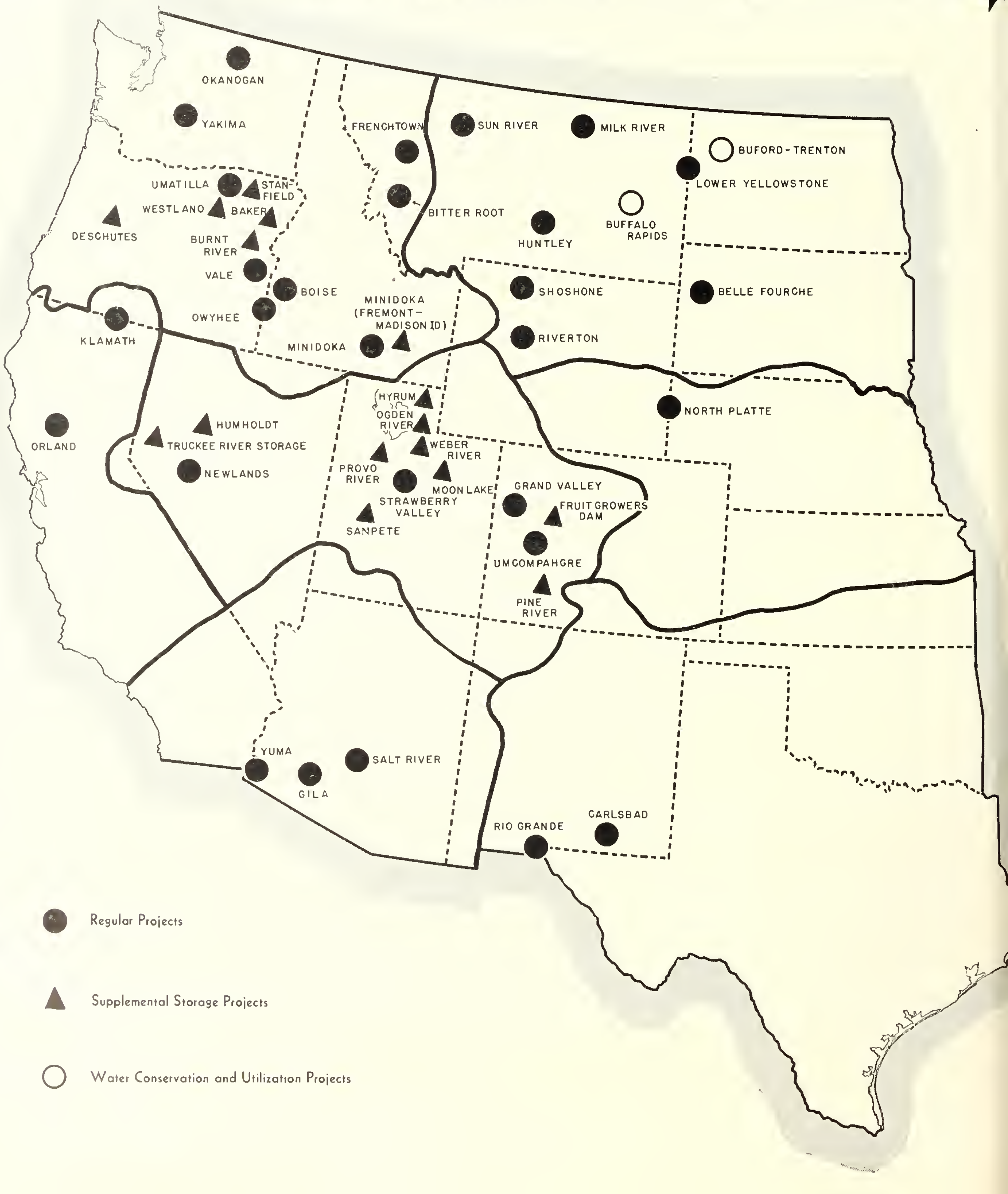
Around the city of Klamath Falls, in southern Oregon, is the fertile area of the Klamath project. In addition to the land within the project boundaries, water is furnished to a number of irrigation districts in the vicinity and a large area of public land reserved for reclamation purposes is leased for agricultural use. In all these areas, there were 51,000 acres planted to barley in 1945 and 2,950,000 bushels produced. An important crop on this project, particularly

(*Continued on page 226*)

TAKE A LOOK AT RECL

Western Farmers Come Through With

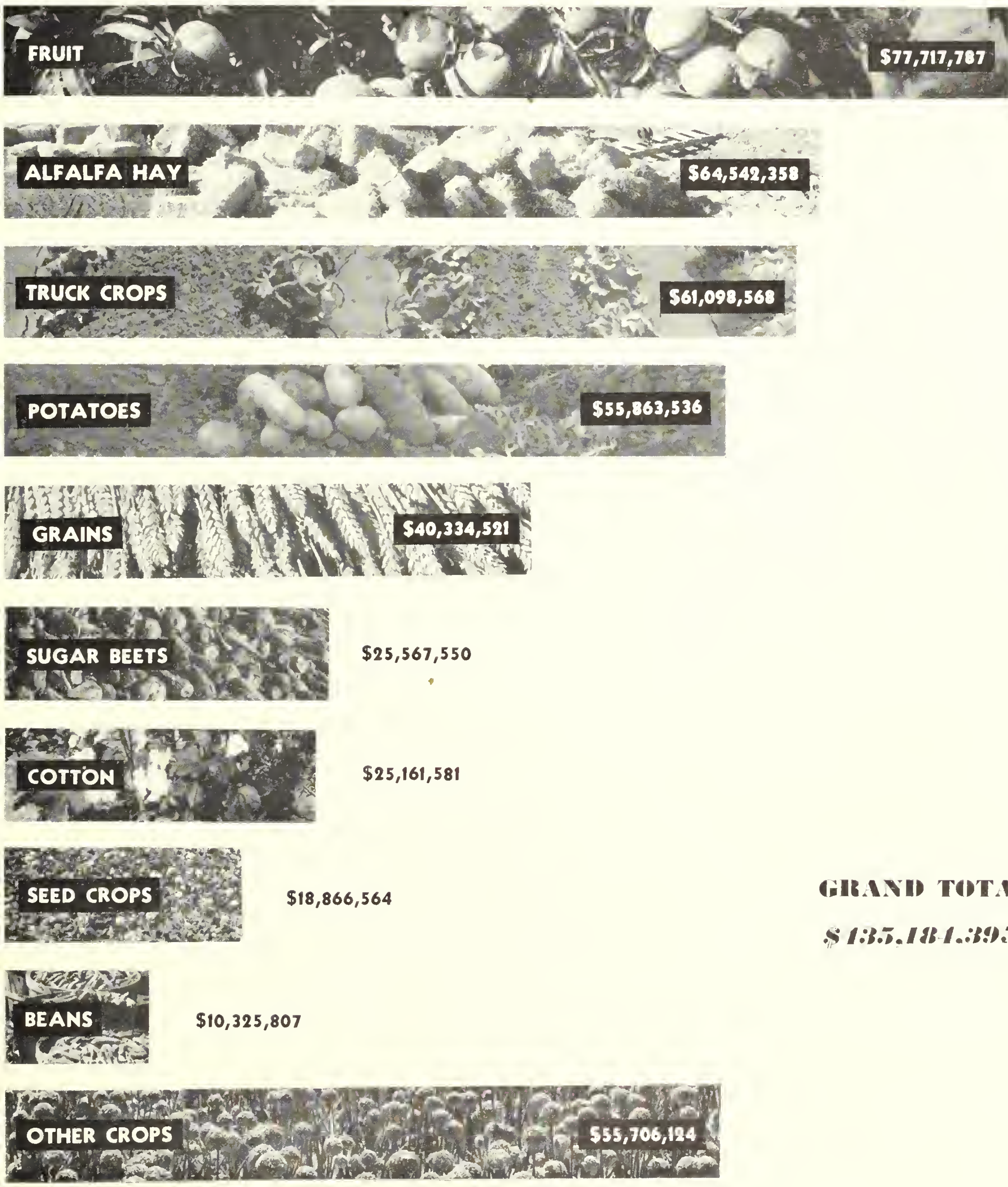
These 46 Irrigation Projects Produced



ATION'S 1945 HARVEST

Worth More Than 435 Million Dollars

Record-Breaking Money Crops



GRAND TOTAL

$435,184,395

A LOOK AT THE CROPS

(*Continued from page 223*)

during the recent war years, is the Irish potato, with 27,000 acres planted last year and 9,570,000 bushels produced.

In central Washington the Yakima project in 1945 produced tremendous quantities of foodstuffs, such as 4,000 acres of asparagus with 17,700,000 pounds harvested, and 10,000 acres of potatoes producing 2,990,000 bushels. The Yakima project is also famous for its fruit—14,222 acres of apple trees, and over 18,400 acres in peaches, pears, prunes, cherries, apricots, and other fruit, including 2,000 acres of grapes which is an increasingly successful crop on this project. Another major crop on the Yakima project is hops. In 1945 there were 3,800 acres planted to hops, the harvested crop being worth $4,500,000. And these figures are only for Kennewick, Kittitas, Sunnyside, and Tieton, the four principal divisions of the Yakima project and do not include production for 152,000 acres in the Yakima Valley which are furnished water under special contracts.

War Food Projects

On the new Roza division of the Yakima project, construction was pushed during the war years because the land could be developed rapidly and contribute substantial quantities of food. Water service commenced in 1941, and, in spite of scarcities of materials and labor, the irrigated area expanded each year until in 1945 there were 18,500 acres in production. One-third of the acreage was in vegetables, and the gross crop value for the 5 years the project lands have been in production totals nearly $10,000,000. Construction work is still in progress, and additional acreages will come into production in 1946.

On the Minidoka, Boise, Owyhee, and Vale projects in southern Idaho and eastern Oregon, some of the principal staple food and fiber crops and increasing quantities of vegetables are raised. In 1945 these projects had 64,500 acres planted to potatoes and 13,300,000 bushels were harvested. There were 30,000 acres in sugar beets and 500,000 tons produced in this area, with exceptionally high yields. Alfalfa hay was produced on 163,000 acres in these four projects.

Today about 2,500,000 more people live in the 11 far Western States than resided there in 1940. Many of these migrated westward during the war to work in shipyards, aeroplane factories, and steel plants. Many of these people have remained in the West and the reconversion to peacetime production of such industries as the Geneva steel plant in Utah has created continued opportunities for employment. As industries continue to develop in the West, it seems that logically enough irrigated agriculture will have to expand to keep pace with them. The food processing industry can also expect a boost in business as a marketing outlet for farm products. This means the creation of new jobs for industrial workers. With the development of modern transportation methods, such as air express, new food preparation methods, including dehydration and quickfreeze, the products of irrigation farms are given extra leases on the amount of time they remain marketable. These are the factors which influence crop patterns and the prosperity of the farmers on Federal projects. New canneries in an area are followed by larger acreages in vegetables and fruits. Improved methods of marketing are bringing the irrigation project closer to the consumer. East may be East and West may be West, but Reclamation crops benefit the entire Nation.

(Note: Figures used in this article are based on crop reports from 46 Reclamation projects, plus additional estimates for land outside project areas which received surplus water from Bureau of Reclamation storage systems, or by means of special facilities such as the All-American Canal.)

VALUE OF CROPS RAISED ON RECLAMATION PROJECTS

Region	State	Project	Value [1]
I	Idaho	Boise	$23,087,659
		Minidoka	69,252,934
	Montana	Bitter Root	686,955
		Frenchtown	131,740
	Oregon	Baker	209,206
		Burnt River	385,719
		Deschutes	3,094,854
		Stanfield	177,008
		Umatilla	577,153
		Vale	2,371,300
		Westland	136,914
	Oregon-Idaho	Owyhee	11,118,655
	Washington	Okanogan	2,436,849
		Yakima	78,069,920
	Total		191,736,866
II	California	Central Valley	18,302,432
		Orland	1,558,785
	Oregon-California	Klamath	17,753,998
	Total		37,615,215
III	Arizona	Gila	177,578
		Salt River	41,411,702
	Arizona-California	Yuma	8,406,503
	California	All American Canal	62,298,113
	Total		112,293,896
IV	Colorado	Fruitgrowers Dam	249,779
		Grand Valley	5,387,156
		Pine River	626,840
		Uncompahgre	3,196,433
	Nevada	Humboldt	1,034,666
		Newlands	2,302,684
		Truckee River Storage	
	Utah	Hyrum	289,767
		Moon Lake	779,372
		Ogden River	1,292,227
		Provo River	4,276,065
		Sanpete	280,964
		Strawberry Valley	3,096,359
		Weber River	13,797,750
	Total		36,610,062
V	New Mexico	Carlsbad	1,539,967
	New Mexico-Texas	Rio Grande	24,446,770
			25,986,737
VI	Montana	Buffalo Rapids—First Div	579,906
		Second Div	60,979
		Huntley	1,261,667
		Milk River	2,778,949
		Sun River	1,747,817
	Montana-North Dakota	Lower Yellowstone	2,729,751
	North Dakota	Buford-Trenton	177,783
	South Dakota	Belle Fourche	1,409,945
	Wyoming	Riverton	1,483,936
		Shoshone	2,485,693
			14,716,426
VII	Nebraska-Wyoming	North Platte	16,225,193
	Grand total all regions		435,184,395

[1] Value includes regular projects, storage projects, special and Warren Act lands, and additional areas reported: Temporarily suspended and leased areas, W R A center, etc.

Warne Again Heads President's San Diego Water Supply Committee

Assistant Commissioner of Reclamation Warne has been named chairman of the reconstituted President's Committee on Methods of Financing the San Diego Water Supply Project. The Committee will study ways and means leading toward the completion of the San Diego Aqueduct. Mr. Warne was originally named chairman of this Committee by the late President Franklin Delano Roosevelt.

THE OTHER SIDE OF THE CROP PICTURE

DROUGHT IN THE SOUTHWEST

by Lloyd E. Mulligan
Region V, Amarillo, Texas

During the summer of 1946, farmers in the Southwest area of the United States were faced with some of the worst drought conditions and water shortages to confront them within the past decade.

Continued hot weather, coupled with a lack of rainfall, lowered available water supplies to a critical point. Rainfall in the area was below normal for most of the summer months.

Over 2 million dollars worth of crops were endangered in the State of New Mexico alone.

Mountain streams in northern and southwestern New Mexico dried up as a result of the drought, and other streams ran so low that coons, bears, crows, hawks, and snakes were preying on trout. Game animals throughout the State also suffered.

The once mighty Rio Grande became a long, winding ribbon of rippling sand.

Further evidence of the acute water shortage was seen in the reports on water storage at Elephant Butte Dam. The reservoir, with a capacity of 2,219,000 acre-feet, had only 830,000 acre-feet in storage on July 1, a decline of 69,000 acre-feet in a 30-day period. Records show that since 1942 the inflow for Elephant Butte has been below normal. Reclamation Bureau officials said in a statement to the press, "We have been drawing on our reserves since 1942." And the reservoir today is lower than it has been since 1941.

Drought conditions prevailed throughout the State of Texas. Scattered showers gave some relief, but no general rain fell throughout the area.

Range feed suffered further deterioration, and in the western two-thirds of the State range grass supplies were declared "critically short," with brush and mesquite beans providing the bulk of the active feed on many of the heavily stocked ranges.

Subsoil moisture was generally adequate in Texas coastal counties, but rains were inadequate even in that area. Scattered showers were effective only in a few high plains counties.

In the Lower Rio Grande Valley, field work was retarded because of the heat, and limited water necessitated a 3-day pumping holiday.

The crop-by-crop report:

Corn.—Harvest was under way in all major-producing areas. Late sorghums in all areas were burning, with some high plains acreage and some acreage elsewhere "apparently deteriorated beyond much hope for recovery."

Rice.—All areas were harvesting early varieties and conditions were favorable for rapid maturity of late varieties.

OUR BACK COVER

River of Sand

The wages of drought are dry river beds such as the Chinle Wash, located in Canyon De Chelly, Ariz. This picture was taken in June and provides graphic evidence of the effect of last summer's drought in the Southwest.

Sweetpotatoes.—Early planted crops were being harvested in most districts and fair yields were in prospect, but all growing crops for later production were reported badly in need of rain.

Peanuts.—Harvest made "exceptionally good" progress in all southern counties, but late crops in these counties needed rain. The main peanut crop in all other sections of the State was badly in need of moisture.

Cotton.—Continued hot, dry weather retarded development of the crop in central, northern, and northwestern districts. Dry land cotton in the high plains and low rolling plains suffered from drought and hot winds, with early crops opening prematurely and later crops making poor growth.

Farmers throughout the Southwest were hurrying to complete their own irrigation wells, and plans were going ahead to pump water from drainage ditches into irrigation ditches.

Lack of moisture, accompanied by dry winds and above normal temperatures, dried up ranges and crops in much of the State.

Of the irrigation districts, those along the Pecos River appear to be the hardest hit. Four dams impounded only 25 percent of the water held a year ago, when they were also below normal in storage.

But despite almost unprecedented drought conditions, farmers in the Rio Grande Basin from Elephant Butte Dam to below El Paso stored a bountiful harvest of onions, alfalfa, potatoes, and other crops. This was the pay-off on irrigation water available from the Bureau-constructed Caballo and Elephant Butte Dams. The harvest was there, even though the two dams were impounding only 65 percent of the water held a year before, when they were also below normal in storage.

Farmers in the vicinity of Las Cruces, N. Mex., were high in their praises of irrigation and irrigation works. "If we had not had irrigation this year, we would have taken a terrific loss; instead, we were able to make a successful harvest all around," a spokesman for the group said.

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity	Aug. 31, 1945	Aug. 31, 1946
Region 1	Baker	Thief Valley	17, 400	8, 155	6, 600
	Boise	Arrowrock	286, 500	75, 840	134, 000
		Deadwood	161, 900	124, 200	123, 900
		Deer Flat	177, 150	43, 940	41, 600
	Columbia Basin	Roosevelt Lake	5, 220, 000	5, 354, 000	5, 220, 000
	Deschutes	Crane Prairie	50, 000	9, 170	40, 000
		Wickiup	187, 000	36, 785	43, 500
	Minidoka	American Falls	1, 700, 000	1, 044, 950	818, 800
		Jackson Lake	847, 000	640, 950	459, 900
		Lake Walcott	95, 180	95, 670	97, 100
		Grassy Lake	15, 180	15, 180	12, 100
		Island Park	127, 265	103, 765	61, 400
	Okanogan	Conconully	13, 000	5, 025	6, 000
		Salmon Lake	10, 500	9, 955	10, 000
	Owyhee	Owyhee	715, 000	534, 020	454, 900
	Umatilla	Cold Springs	50, 000	11, 525	10, 900
		McKay	73, 800	25, 900	26, 500
	Vale	Agency Valley	60, 000	49, 430	22, 300
		Warm Springs	170, 000	63, 580	104, 800
	Yakima	Bumping Lake	33, 800	13, 170	11, 100
		Clear Creek	5, 300	5, 300	5, 300
		Cle Elum	435, 700	161, 590	277, 700
		Kachess	239, 000	133, 730	165, 400
		Keechelus	153, 000	51, 910	109, 200
		Tieton	197, 000	139, 390	160, 000
Region 2	Central Valley	Millerton Lake	503, 140	292, 415	235, 400
		Shasta	4, 389, 150	1, 973, 200	2, 507, 100
	Klamath	Clear Lake	437, 480	247, 180	220, 400
		Gerber	94, 265	52, 290	31, 300
		Upper Klamath Lake	524, 800	173, 080	212, 000
	Orland	East Park	51, 000	30, 920	25, 400
		Stony Gorge	50, 200	7, 740	4, 900
Region 3	Boulder	Lake Mead	27, 935, 000	22, 134, 000	19, 154, 000
	Parker	Havasu	688, 000	649, 550	665, 500
	Salt River	Bartlett	179, 480	33, 454	14, 200
		Horseshoe	67, 900	- -	8, 400
		Horse Mesa	244, 500	235, 130	229, 900
		Mormon Flat	57, 800	53, 265	54, 500
		Roosevelt	1, 398, 430	608, 735	38, 100
		Stewart Mountain	70, 000	50, 375	43, 100
Region 4	Fruit Growers	Fruit Growers	4, 500	----------	700
	Humboldt	Rye Patch	179, 000	172, 135	153, 900
	Hyrum	Hyrum	15, 280	8, 045	7, 100
	Moon Lake	Moon Lake	35, 760	16, 820	2, 100
		Midview	5, 785	5, 510	4, 300
	Newlands	Lahontan	273, 600	200, 750	208, 100
		Lake Tahoe	732, 000	519, 600	675, 600
	Ogden River	Pine View	44, 175	26, 200	14, 500
	Pine River	Vallecito	126, 280	60, 910	58, 100
	Provo River	Deer Creek	172, 345	69, 375	117, 000
	Strawberry Valley	Strawberry	270, 000	116, 055	111, 500
	Uncompahgre	Taylor Park	106, 230	100, 400	90, 000
	Weber River	Echo	73, 940	43, 920	33, 500
Region 5	Altus	Altus	140, 000	21, 100	9, 700
	Carlsbad	Alamogordo	128, 340	20, 925	24, 700
		Avalon	6, 000	1, 200	900
	Colorado River	Marshall Ford	810, 500	1, 058, 725	551, 600
	Rio Grande	Caballo	345, 870	27, 550	25, 700
		Elephant Butte	1, 830, 300	1, 351, 200	680, 000
	Tucumcari	Conchas	300, 000	261, 510	238, 700
Region 6	Belle Fourche	Belle Fourche	177, 510	110, 040	216, 300
	Huntley	Anita	400	400	300
	Milk River	Fresno	127, 200	42, 670	43, 900
		Nelson	66, 800	30, 130	24, 500
		Sherburne Lake	66, 100	21, 760	27, 600
	Riverton	Bull Lake	152, 000	111, 655	103, 700
		Pilot Butte	31, 500	13, 100	6, 200
	Shoshone	Buffalo Bill	456, 600	445, 335	400, 400
	Sun River	Gibson	105, 000	19, 370	41, 700
		Pishkun	32, 050	27, 025	21, 000
		Willow Creek	32, 300	14, 980	12, 800
Region 7	Colorado-Big Thompson	Green Mountain	146, 890	143, 540	145, 200
	Kendrick	Alcova	190, 500	138, 600	128, 400
		Seminoe	970, 000	725, 750	555, 700
	North Platte	Guernsey	41, 050	15, 020	13, 000
		Lake Alice	11, 000	4, 520	1, 500
		Lake Minatare	57, 000	31, 680	11, 100
		Pathfinder	1, 040, 500	23, 380	9, 200

CORRALLING THE COLORADO

(*Continued from page 220*)

The cash return will be substantial, but it is only a fraction of what the total dividends would be to the American people from full development of the Colorado River and the resources of its basin. New irrigation farms would mean more and better food for the Nation. Opening of new lands to settlement would provide opportunities for veterans and others on irrigated farms and for establishment of new business and industries in adjoining towns. Electricity made available at low cost would be a further stimulant to business and industrial development, with a resultant increase in employment. Great new markets would be opened for the products of labor and industry in other parts of the country as the result of the Basin's increased population and purchasing power.

It was just 15 years ago that the first crew of men moved into Black Canyon, gazed up in awe and apprehension at its sheer walls, and started to build Boulder Dam. Today, that monolith of steel and concrete stands as a monument not only to man's engineering skill, but to his resourcefulness, determination, and courage. Boulder Dam has done more than merely curb the fury and destructiveness of an unbridled river. It has demonstrated what that mastery can mean in terms of economic and social benefit to the people of the Nation it serves. It has pointed the way to the tremendous possibilities for future development, and given us a river to command in the building of a great new inland empire.

(To be concluded in November)

Part III of "Corralling the Colorado" will outline a solution to the immediate and pressing problems concerning the Colorado River Basin and summarize what the Basin States have already done about reaching an agreement on the proposed plans for basin-wide development.

Personnel and Project Directory

During the past month the following changes were made in the Personnel and Project Directory: Robert W. Fifield succeeded Floyd F. Lucas as manager of the Deaver Irrigation District, Deaver, Wyo., and William P. Peebler replaced E. F. Andrews as Secretary of the same District. In accordance with the notice in the September issue the next directory will appear in the December Era. You will be informed of any changes in the forthcoming issues.

WATER REPORT: *The Rains Came, but too Late in Some Areas to Save the Crops*

The drought has been broken in southwestern Oklahoma and in northern, southern, and eastern Texas by rains during the latter part of August. Generally, the drought conditions throughout the entire Southwest have improved, for the second successive month, but the water supply remains considerably below normal in many areas.

Ground water and stream-flow measurements for August, made by the Geological Survey of the Department of the Interior, range from 250 percent of normal in north central Arizona to 9 percent of normal in central South Dakota. Stream flows varied from cloudburst floods in some parts of Colorado and Wyoming to below normal in Utah, New Mexico, and in southern Arizona.

Stream flows and well levels are plotted on the map reproduced below.

The stream flow and surface run-off were below normal in Arizona, Montana, Nebraska, Nevada, New Mexico, South Dakota, western Texas, and Utah.

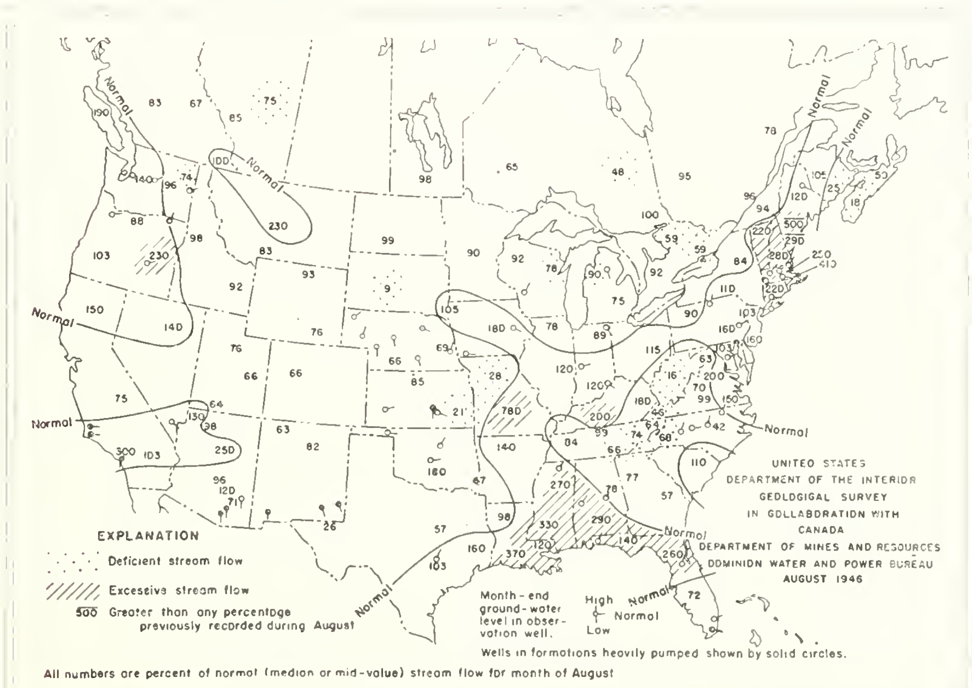
Water supply for irrigation and power generation for the 1946 season are near the lowest on record in the Colorado River Basin. Supplies of water have been adequate for the irrigation needs of the Gila and Yuma projects and the Imperial Irrigation District, by utilizing water stored in Lake Mead.

In central Arizona, drought conditions have been so severe that a serious shortage of water for both irrigation and power generation has resulted. To augment meager water storage, additional water for irrigation has been pumped from wells, resulting in an abnormal lowering of the ground water table. During August the flow of the Gila, Verde, and Salt Rivers was over twice that in July, resulting in considerable improvement in the drought area. Although storage reserves are still considerably below normal, some improvement in the general outlook was noted during the month. Withdrawals from the Salt and Verde River system above Granite Reef Dam were not as heavy in August as in July and somewhat less than seasonal average. Information is not yet available to indicate definitely the decrease in crop production in central Arizona as a result of this year's inadequate water supply, but it is estimated that the total agricultural income for central Arizona will be several million dollars less than could have been produced with adequate water.

Run-off of the Rio Grande River in New Mexico was still below normal during August, but was an increase over June and July. The greater-than-usual drafts on the storage of Elephant Butte and Cabello Reservoirs decreased the reserves of these two reservoirs to the lowest since July 1941.

Widely scattered thunderstorms and local showers during August brought considerable relief to much of the drought-stricken area in Utah. Surface run-off increased in comparison with previous months but is still below normal.

To compare the amount of water stored in Bureau of Reclamation reservoirs last year with this year's storage, see the table on the opposite page.



SPRINKLER SYSTEMS—*pro and con*

by M. R. LEWIS

Irrigation Engineer, Region I, Boise, Idaho

What you ought to know before you invest in a sprinkling system for your irrigation farm.

Unfortunately, there is a tendency toward unwarranted generalization in statements on irrigation by sprinkling. Purveyors of sprinkler equipment and of power or power units know of many instances where sprinkler irrigation has been successful, even of cases where it has properly and profitably displaced surface methods. On the other hand, men long accustomed to successful irrigation by surface methods note the costs incurred in installing and operating sprinkler systems and are inclined to "pooh pooh" the use of sprinklers under any conditions.

The facts are that neither surface nor sprinkler methods are always best and that many factors are involved in the relative merits of the two systems for any particular farm.

The only general statement possible is that where conditions are more or less ideal for surface methods, these will be found most economical; but that as conditions become less favorable for surface methods, sprinkling becomes relatively more economical and in some cases will surpass surface methods in economy of water, labor, and money.

Few data are available from which the line of demarcation between the two systems in over-all economy can be fixed. Even if ample basic data were available, each farm unit would constitute a special problem. The more important variables are: soil texture, topography, cost of water, and cost of power on farm units of all sizes. On small units the shape and size of fields, the source of water, the labor management program, and the rate of flow of the irrigation water become especially important. One must consider the initial or installation cost of the sprinkler system as compared with the cost of land preparation for surface methods and the maintenance, as well as power and labor costs for both systems.

Savings in Water

Under certain conditions, the use of sprinklers will make possible important savings in water, but it does not follow that sprinklers are always more efficient in this respect. Where the soil is extremely permeable, is on steep slopes, or is very slightly permeable on moderate or steep slopes, the saving in water by the use of sprinklers properly adjusted to the conditions may be very considerable. On steep land they also make possible control of the erosion of the soil. Contrary to popular belief, sprinkler irrigation is not foolproof. Unless the sprinklers are adapted to the conditions, it is possible to waste both water and soil. It happens occasionally that sprinklers are operated so long on sandy soil that losses by deep percolation occur, but more often irrigation applications are too small and too frequent resulting in excessive loss by evaporation. The rate of application may be too rapid on sloping land with resulting run-off and erosion.

Probably the best study of the cost of applying water by sprinkling so far published is California Agricultural Experiment Station Bulletin 670, "Irrigation by Sprinkling" by J. E. Christiansen. This publication describes 37 portable irrigation systems in use in the Sacramento Valley and gives data on operation. At the time of the study daily wages ranged from $2.25 to $4.18 and irrigators commonly worked 12 hours a day. All of the systems were operated by tractors or other internal combustion engines. The labor cost ranged from 32 cents to $1.38 per acre-inch of water applied while power cost (almost entirely fuel and oil) ranged from 7 to 45 cents per acre-inch. The average application at each irrigation for the 37 plants was 2.6 inches in depth and the average costs were 57 cents for labor and 22 cents for power per acre-inch and $1.48 for labor and 57 cents for power per acre per application. Converting the average figures to man-hours, we find that it took 2.2 man hours to apply an acre-inch or 5.7 man-hours to irrigate an acre on the average. The number of applications per season are not reported.

Labor Costs

These systems are fully portable and therefore, the labor cost was slightly greater than it would have been for the semiportable type of system usually employed in the Northwest. The figures given above include the labor necessary for maintenance of the systems and for this reason, too, are greater than those covering only the moving of portable pipe lines.

Scattered information from various sources indicate that the man-hours required to move the lateral lines on the semiportable systems common in the Northwest will range from one-half to 2 hours per acre. An even greater range is found in the man-hour requirements by surface methods

Under adverse conditions an irrigator may be able to handle only one cubic foot per second or less. A stream of this size will provide one acre-inch per hour, thus indicating a labor requirment of one or more man-hours per acre-inch. With tight soils on sloping land the time required for a satisfactory irrigation may be 24 hours or longer, and the percentage of waste may be very high. The result may well be a gross application of 6 or more inches in depth thus resulting in a labor requirement of 6 man-hours per acre irrigated. At the other extreme, on sandy or gravelly soil with adequate farm ditches and structures, one man may handle 8 or 10 cubic feet per second and make gross applications of 3 inches in depth, thus using three-tenths or four-tenths of a man-hour per acre.

Cost of Equipment

The initial cost of semiportable sprinkler systems also will vary greatly. At present, the price range will generally fall between $40 and $100 per acre. On the other hand, the cost of preparing land for surface methods may be of the same order.

The proponents of sprinkler irrigation make great claims for saving of water. These claims are supported by specific instances. Where careless or unsuitable methods of surface irrigation are used on very permeable or very slightly permeable lands the loss of water by deep percolation or surface waste may be very high. Properly adjusted and operated sprinkler systems will save a large part of these losses. On the other hand, suitable and properly operated surface methods on all lands of good topography, excepting those at the two extremes of the permeability, range, will result in equally efficient use of irrigation water. Irrigation of alfalfa and pasture by the strip border method, as used by good farmers in the region, on the Umatilla Field Station, Hermiston, Oreg., cited in the report on Problem 4, Columbia Basin Joint Investigations, resulted in application efficiencies of 75 to 100 percent. These are fully as good as could have been achieved by sprinklers.

It is claimed, with considerable justification, that sprinkler irrigation does not require the services of a skilled irrigator. Here again the matter is a relative one. Hardly any more skill and much less strength and endurance are required to handle the water on a system like that cited above on Umatilla Field Station than on the usual portable or semiportable sprinkler system. On the other hand, great skill is required to irrigate steep, slightly permeable land by surface methods without serious loss of water and soil. Under such conditions, sprinklers are more easily controlled.

Another factor is important on small farm units and that is the distribution of the farmer's time. On dairy and some other types of small farms, it is much easier to handle the irrigation as a daily chore, requiring an hour or so to move sprinkler lines, than to spend more or less full time for a day or more, two or three times a month, irrigating with a large stream by surface methods.

To irrigate by sprinkling . . .

The source of water supply and the rate at which it flows may be highly important on small farms. A small stream from a spring or well can often be used very satisfactorily in a sprinkler system where it would be difficult to handle efficiently by surface methods.

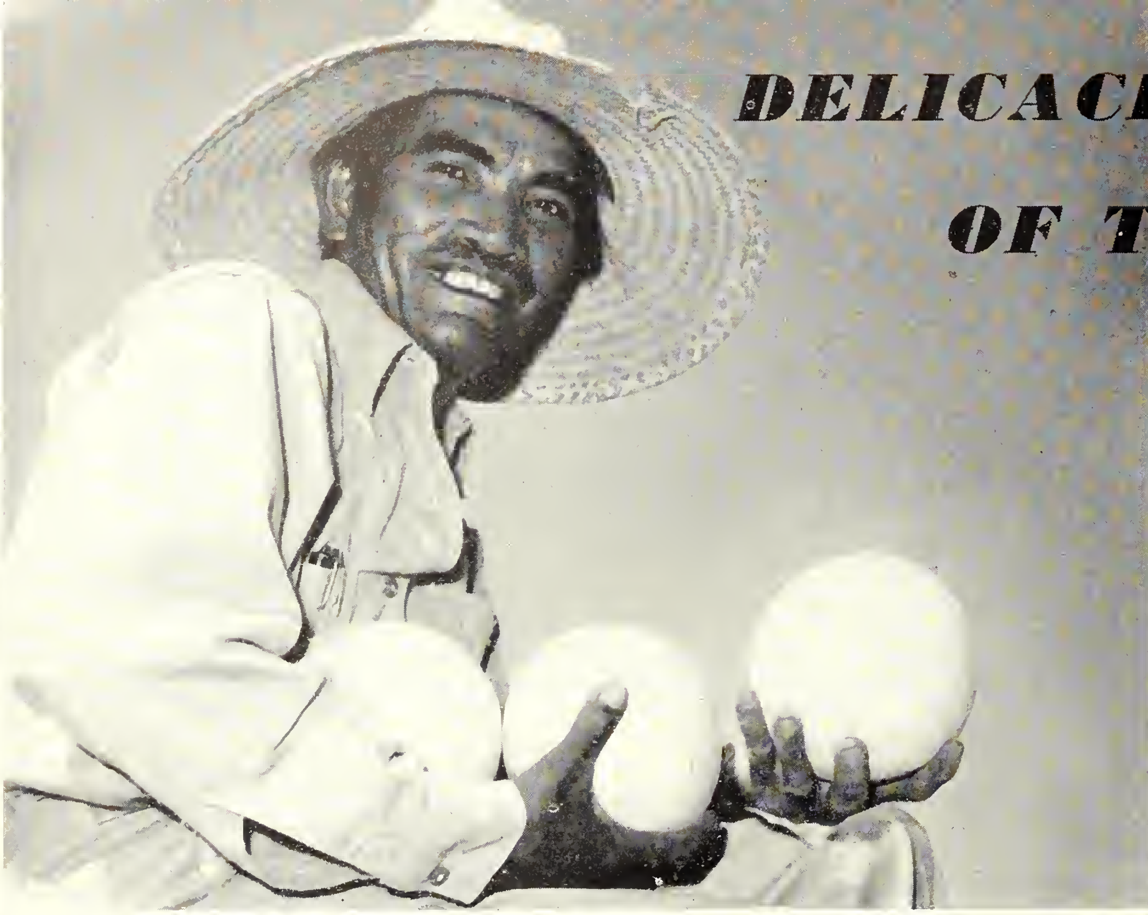
All of this bears out the opinion expressed at the beginning of this article, that each farm unit must be studied on its merits, but that, in general, surface methods are more economical in labor and money and equally so in use of water, where conditions are suitable, but—where conditions do not favor surface methods—sprinkling may be more economical in labor, money, and water.

In 1942, Dr. E. N. Torbert, now regional planning engineer, Region 1, prepared a memorandum on, "Irrigation sprinkling in relation to development of large scale pastures" in connection with the Columbia Basin Joint Investigations. This memorandum summarized the data available at that time, and few new data have been secured since that date. There is need for further study of this problem.

Some troubles, not widespread, and probably not serious, have developed in the use of aluminum and magnesium pipes in irrigation. It has been found that some soils and some waters attack the light metal alloys now being used. In some instances, pin holes have developed in the portable aluminum pipes and serious corrosion of magnesium pipe has taken place in a matter of months. The Bonneville Administration and Washington State College are studying the problem.

Or to irrigate by surface methods . . .

DELICACIES OF THE DESERT



Records fell as the farmers on the Burea
of Reclamation's Yuma project harveste
their melon crop this year. More than 870,
600 crates of cantaloupes, honeydews, an
honeyballs were loaded into 2,517 refriger
ator cars and shipped to markets all ove
the country.

Commanding the O. P. A. ceiling pric
for most of the season, the melons produce
an estimated gross income of nearly $4,000
000 for the season.

Here is a break-down showing the acre
age, number of crates, and number of car
shipped from the project:

	Acres	Crates	Cars
Cantaloupes	6, 914	754, 147	2, 14
Honeydews	444	88, 800	2
Honeyballs	300	27, 714	
Total	7, 658	870, 661	2, 5

The yield per acre this year was just abou
average, but the farmers planted nearl
twice as many acres in melons as they di
in 1945.

Next to lettuce, cantaloupes and othe
melons are the most important truck cro
on the project. The hustle and bustle o
gathering this crop creates one of the mos
colorful harvest seasons in the Yuma area.

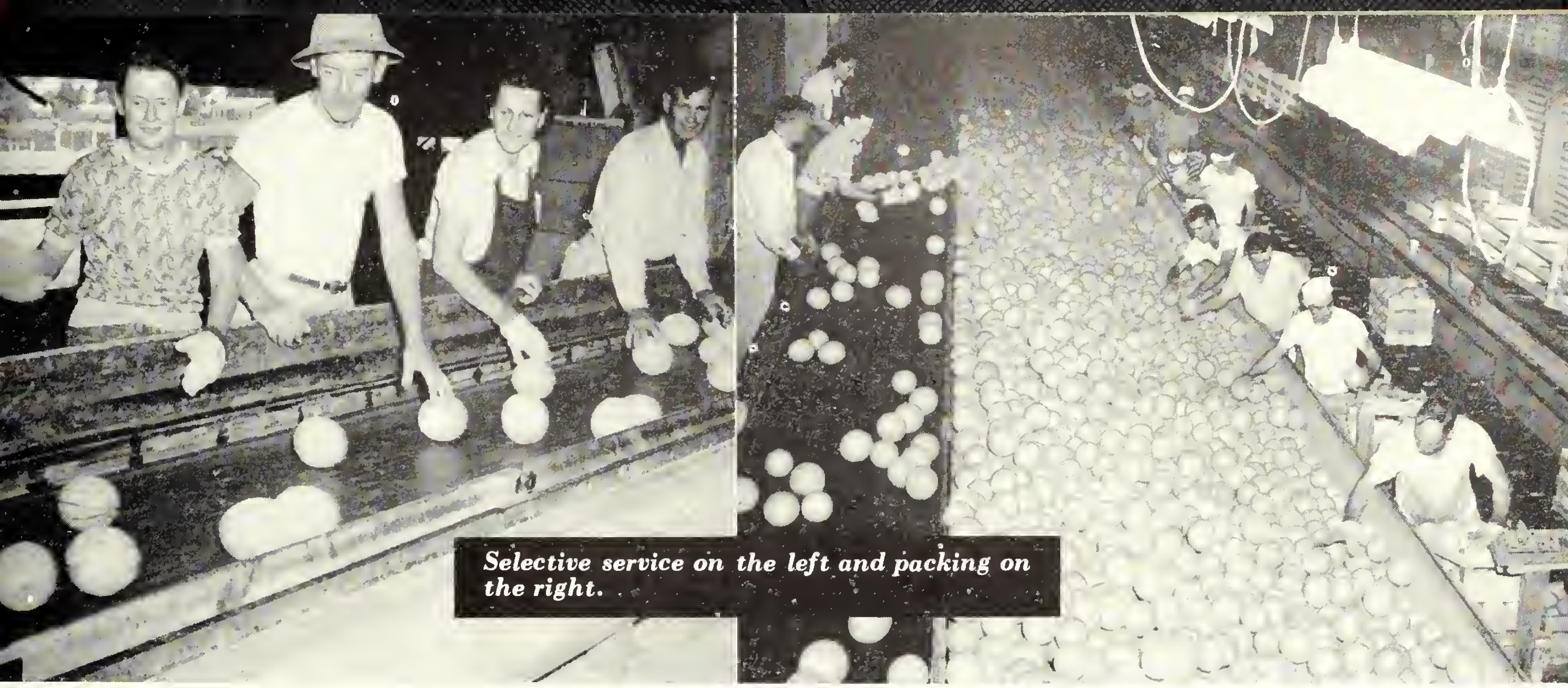
The melons must be picked at exactly th
right time so they will not spoil durin
shipment. Scores of picking crews bosse
by experienced foremen descend upon th
fields and work 7 days a week, covering th
fields from 16 to 20 times to get ever
marketable melon at the right time. Th
crews made good money this year, receiv
ing about 25 cents a crate during the 2
month season.

After the melons are picked they ar
trucked to modern packing sheds to be hur
riedly crated. Before packing, the melon
flow on a conveyor belt through cleanin

Harvest operation No. 1 on a successful melon ranch.

Trucking them in from the fields to the sheds.

Catching a "cooler" in betw pickings.



Selective service on the left and packing on the right.

and waxing machines, and pass by inspectors who cull out those not fit for shipment. To expedite the packing every possible mechanical device is used. Many men and women who work in the sheds move around the West from harvest to harvest. They frequently pack 500 crates daily at from 9 to 14 cents a crate.

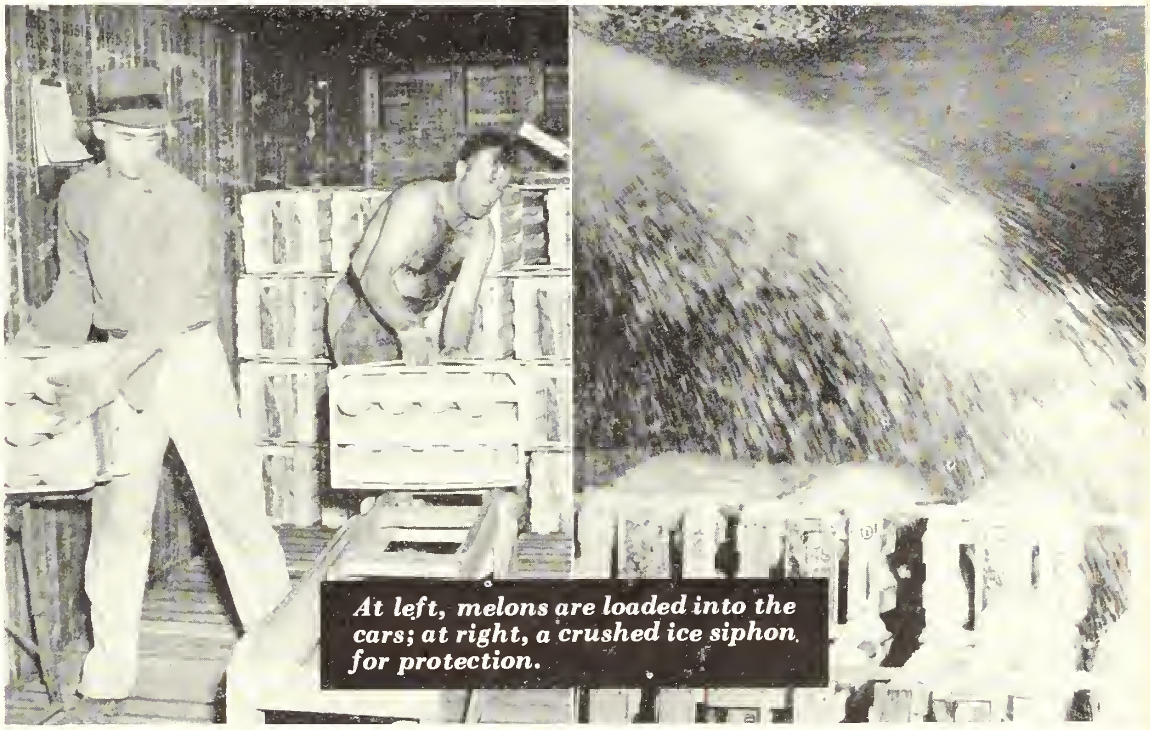
The packers handle so many melons that the skin wears off their hands faster than nature can grow it. This occupational hazard is the big problem of the packers, and they all have their favorite methods of keeping their hands in shape. Some use cotton gloves and dip them in water frequently. Others have developed special rubber pads. Best protection, however, is tough callouses.

People from all walks of life work in the sheds during the short-lived season. One of the best packers in the area is Edgar "Mutt" Ford, athletic coach of the Mesa Union High School, Mesa, Ariz., who made as high as $60 a day during the past season.

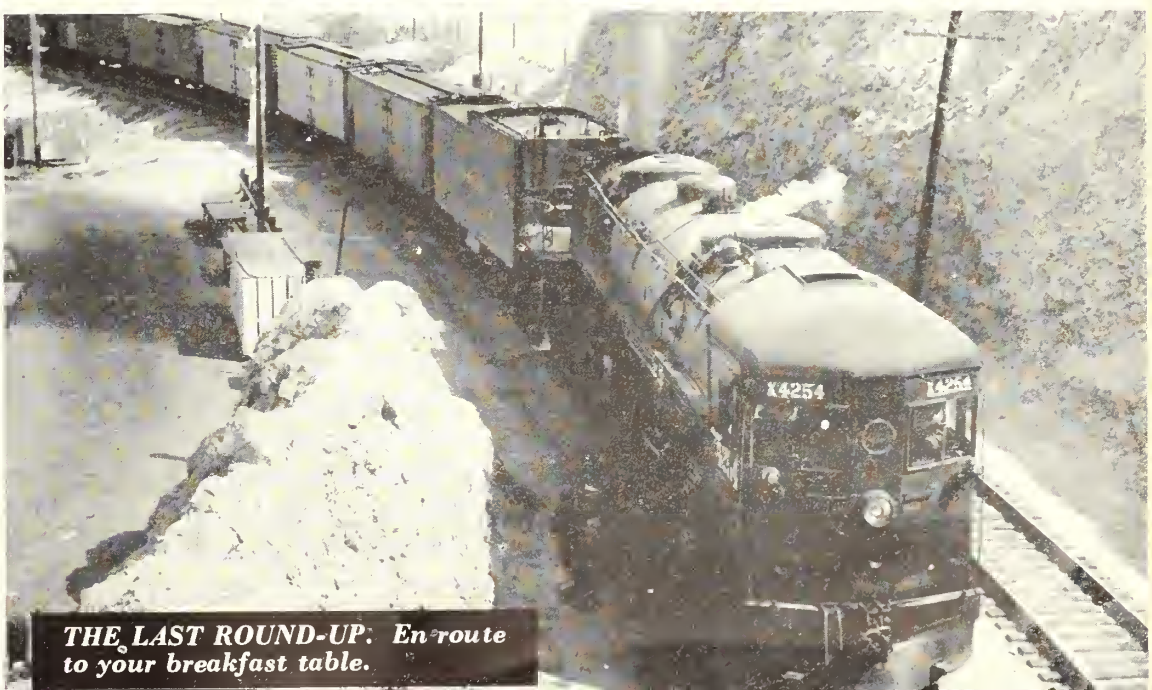
The favorite cantaloupe of the growers in the Yuma project is known as "Melon 45" which was developed in the Imperial Valley of southern California. A quality melon, it has good flavor, thick meat with a small seed cavity. The melon stays firm during the necessary handling of packing and reaches the consumer in good condition.

Honeydew melons are second in popularity in the project. These melons have smooth, white skin and are quite sweet. They are more perishable than cantaloupes and, therefore, harder to get to market in good shape. Honeyballs are a relatively new type and are a cross between cantaloupes and honeydews. The meat is lighter than cantaloupes and somewhat sweeter. The skin is something in between the other two melons having small ridges and being lighter than a cantaloupe.

The next time you see these delicious melons, remember that they represent the organized efforts of the fruit pickers and packers of the Southwest.



At left, melons are loaded into the cars; at right, a crushed ice siphon for protection.



THE LAST ROUND-UP: En route to your breakfast table.

MECHANICAL FIREMEN

by JOSEPH G. TURNER*

No running to the fire alarm at Boulder Dam powerhouse—robots are on the job

Guides at Boulder Dam powerhouse, the largest in the world, are often asked, "What do you do if one of the generators catches on fire?" The correct answer to that question is, "Nothing." Everything is done automatically.

Any fire that might break out in the generators is extinguished by carbon dioxide gas or CO_2. Carbon dioxide is a clean, dry, noncorrosive gas that puts out fires by diluting the oxygen to a point where it will not support combustion. It has several marked advantages over water or any of the chemicals ordinarily used in fire extinguishers. As it is a dry gas, it has no harmful effect on the insulating material with which the generator coils are wrapped. Neither will it harm any of the metal or the paint. It has a ratio of expansion of over 400 to 1. This means that the gas stored in a standard cylinder, 8½ inches in diameter and 51 inches high, will, when released, fill an area over 400 square feet. While expanding, this gas will penetrate small openings and cracks that could not easily be reached by water or liquid chemicals. When released, the gas resembles steam which is cold instead of hot. At the discharge nozzles its temperature is approximately 110° F. below zero.

The installation at Boulder in general consists of a bank of 40 cylinders for each two generators. Each cylinder contains 50 pounds of carbon dioxide at approximately 2,000 pounds per square inch pressure. At this pressure the carbon dioxide is a liquid. These cylinders are discharged into either of the two generator housings or the adjacent switchgear housings, by automatic discharge devices and routing valves.

There are three methods of initiating the discharge. The first is manual. If fire or smoke is observed by an operator, and the automatic devices have not discharged the cylinders, he throws an electrical switch which floods the proper compartment with the carbon dioxide gas from 16 cylinders. This is the simplest method, but will probably never be used.

The second method is automatically by thermostats. The thermostats, which are located in each generator housing and switch compartment, will at a definite temperature, also discharge 16 cylinders into the proper compartment. This method is comparable to the ordinary sprinkler system, where the fire causes the rise in temperature that initiates the extinguishing equipment operation.

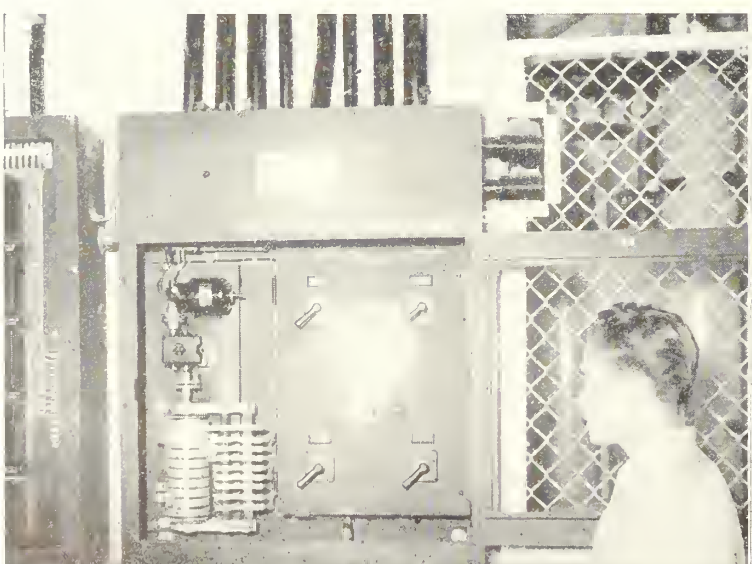
The third method is by relays. The most common cause of fires in electrical equipment is insulation failure. This allows the current to flow to the grounded metal parts of the generator rather than to continue through the windings. The current causes an arc which ignites the insulating material. The relays used for such installations are known as differential relays. They, in effect, measure the current at the two ends of each winding. If there is a difference in the value of current at the two ends of the winding, some must be flowing from the winding to grounded metal parts of the generator. The relays do not wait for a fire to start. As soon as the currents at the two ends of a winding do not balance, the relay operates and automatically does four things: (1) It closes the turbine gates and applies th brakes to the unit; (2) disconnects th generator from the power system; (3) oper the field breaker so that the generator n longer generates current; and (4) di charges 16 cylinders of carbon dioxide g into the generator housing. In short, extinguishes the fire in its earliest stages may even prevent it from ever starting.

In addition to initial discharge of 1 cylinders of carbon dioxide, means are pr vided for later discharges. The initi discharge dilutes the oxygen in the housi or compartment to a point where it will n support combustion. The later discharg are to replace any carbon dioxide that mig escape and thus keep the oxygen sufficient diluted. On some of the generators, this done by an automatic rotating drum switc The drum switch starts to rotate at the tin of the initial discharge. After a time inte val, which is set after initial tests of th installation, an additional four cylinders w be discharged. Provisions are made for total of six of these delayed discharges. C some of the installations these delayed di charges are not automatic but are done ma ually by the operator.

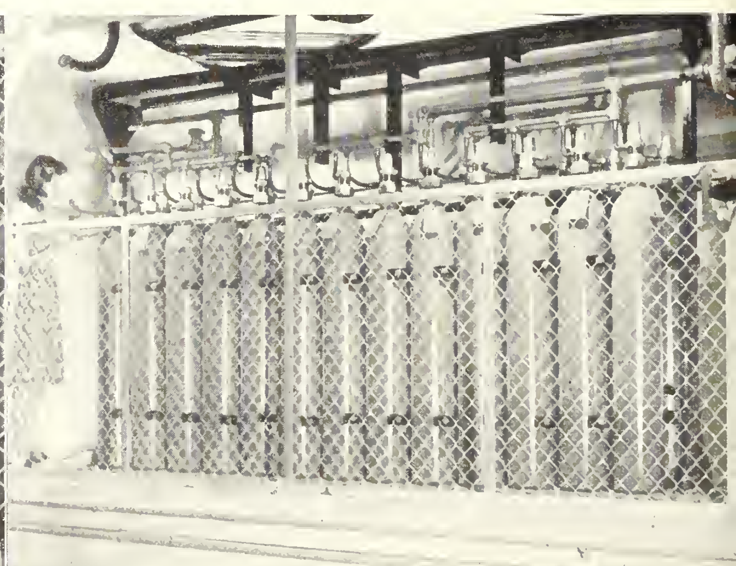
One other task is performed by the equi ment. The switch compartments are no mally cooled by a system of air fans, blowers, and ventilators. If these were a lowed to remain in operation, the carbo dioxide would escape almost as fast as entered the compartment. To prevent thi the equipment automatically stops the blow ers and closes the ventilators whenever ca bon dioxide is discharged into the switc compartment.

*Electrical engineer, Branch of Power Utilization.

Control and test cabinet for fire extinguishing system



Battery of carbondioxide cylinders guards generators



NEWS ROUND-UP

Beet Crop Unbeaten

Federally irrigated beet crops will produce more than 4 pounds of sugar each for every man, woman, and child in the United States, or approximately 570,000,000 pounds according to crop reports received by the Branch of Operation and Maintenance.

Total beet production is estimated at 1,898,495 tons, an increase of 31.2 percent above 1945. The planted acreage exceeds the 1945 acreage by 29.9 percent.

House Bill 5654 Vetoed

A bill to provide certain basic authority for the Bureau of Reclamation, including land leveling and other reimbursable predevelopment work on public land projects, House bill 5654, has been vetoed by the President.

Angostura Dam Started

Assistant Commissioner W. E. Warne, Planning Director J. W. Dixon, Chief Information Officer Barrow Lyons, Chief Personnel Officer Glenn Thompson, E. J. Utz, chief, Division of Land Use and Settlement, Glen Hoyt of Land Utilization, Carl G. Paulson of Geological Survey, and Power Utilization Director H. F. McPhail took part in ground-breaking ceremonies for Angostura Dam near Hot Springs, S. Dak., August 23.

Angostura Dam and Reservoir is one of the initial authorized units of the Missouri Basin program and the first South Dakota unit to get under way.

Colorado Report Submitted

The proposed Colorado River Basin report was formally presented to the newly organized Colorado River Basin States Committee on July 29–30 by Regional Directors E. O. Larson and E. A. Moritz.

The need for unification of effort throughout the basin was stressed by Assistant Commissioner W. E. Warne speaking on the first day of the meeting. The committee is considering the Bureau of Reclamation report in an endeavor to reach a mutual agreement on projects to be built as the next stage of development.

The resignation of the California delegates from the committee of 16 led to the organization of the new committee with two delegates each from the States of Wyoming, Colorado, Utah, New Mexico, Nevada, and Arizona.

Rehabilitation Survey Started

The Bureau of Reclamation is inaugurating an intensified program aimed at the widest and most economical use of western water resources through utilization of existing facilities. This program is a gradual development that has evolved over a period of years and involves: maximum settlement, soil and moisture conservation, low-cost canal linings, accurate water measurements and more closely controlled deliveries, physical and financial rehabilitation of existing projects, control of ditch bank and water weeds, action programs to attack the problems of reservoir and stream bed sedimentation and watershed erosion, sharpened cost analyses, and accelerated reduction of excess acreage.

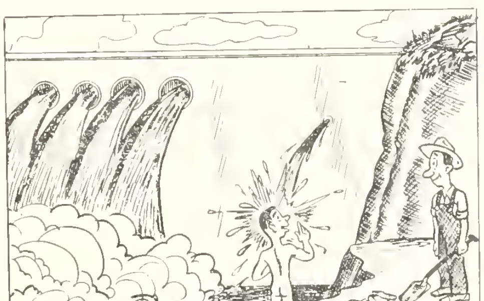
A rehabilitation survey has been launched recently to determine the extent of the conditions affecting over-all efficiency of irrigation systems.

Settlement programs are being accelerated as rapidly as possible; canal-lining investigations are under way in every region and experimental installations have been made in large number; methods of more accurately measuring water deliveries are under consideration; costs are under analysis on a Bureau-wide basis; research stations are being established in the Northwest and in the Southwest for study of weed problems in cooperation with the Bureau of Plant Industry of the Department of Agriculture; and a vigorous program of erosion and sedimentation studies is being launched.

Crop Production High

Despite uncertain labor supply, scarcity of machinery and parts, and inadequate transportation and marketing facilities, farmers on Federal irrigation projects rolled up a huge production in 1945, meeting vital goals set by the Department of Agriculture. Irrigated acreages increased by 56,383 acres to a total of 4,195,732. Crops produced have a total gross value of $435,184,395, an increase over 1944 of $23,958,031.

In all, a total of 11,814,337 tons of food and forage were produced with a notable increase in fruit production over 1944 of 173,488 tons for a total of 901,983 tons.



"The rest of the dam follows Bureau plans—but this was my own idea."

Program Planners' Guide

Many discussion group leaders, community leaders, farm organizations, teachers and librarians and others concerned with current economic and social problems will be interested in a new publication entitled "The Program Planner." It is an 8-page bulletin which calls attention to a large variety of materials prepared for group discussion and entertainment by welfare agencies, both public and private. Sample copies may be obtained from the Program Information Exchange, 41 Maiden Lane, New York 7, N. Y.

More Funds for Missouri Valley

In signing the omnibus flood control and river and harbor bills July 24, President Truman declared that appropriations for construction of the projects authorized would not be sought during the next session of Congress and that, in general, construction would be spread over a long period.

The two acts authorize projects estimated to cost $1,292,395,070. The Department of the Interior and the War Department are each authorized 150 million dollars for prosecution of the Missouri Basin Comprehensive Plan under provisions of the Flood Control Act.

The River and Harbor Act, Public Law 525, contains a proviso that the O'Mahoney-Milliken omendment comprising section 1 of the River and Harbor Act approved March 2, 1945, will govern with respect to all projects authorized by the measure. The Flood Control Act, Public Law 526, provides that the first section of the Flood Control Act of December 22, 1944, would apply to all projects authorized by the measure.

Notes to Contractors

Contracts Awarded During August 1946

Spec. no.	Project and State	Date of award	Description of work	Contractor's name and address	Contract amount
1211 [1]	Davis Dam, Ariz.-Nev	Aug. 1	Electric equipment, Phoenix and Tucson substation.	Southern States Equipment Corp., Hampton, Ga.	$18,582.25
1246 [2]	Kendrick, Wyo	Aug. 3	Transformers for Casper and Alcava substation.	Allis-Chalmers Manufacturing Co., Milwaukee, Wis.	156,604.00
1254	Columbia Basin, Wash	Aug. 28	Six coaster gates—Grand Coulee	American Bridge Co., Denver, Colo	200,207.00
1257	Yakima-Roza, Wash	Aug. 30	Outdoor pumping units	Worthington Pump & Machinery Corp., Harrison, N. J.	118,550.00
1283	do	do	do	do	61,102.00
1287	Davis Dam, Ariz.-Nev	Aug. 3	Turbines for Davis power plant	Baldwin Locomotive Works, Eddystone, Pa	2,083,800.00
1327 [3]	Central Valley, Calif	Aug. 2	Automatic floats and indicators	Monarch Forge and Machine Works, Portland, Oreg.	10,575.00
1341	Columbia Basin, Wash	Aug. 1	Materials for steel warehouse	American Bridge Co., Denver, Colo	76,738.00
1349	Missouri, Basin, Wyo	Aug. 2	Construction of buildings, Boysen government camp.	Dawson, Corbett & Shelp, Rawlins, Wyo	189,225.00
1370	Davis Dam, Ariz.-Nev	do	Structural steel—Parker power plant	Muskogee Iron Works, Dallas, Tex	25,725.00
1371	do	Aug. 5	Galvanized-steel transmission towers	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	25,485.00
1377	Columbia Basin, Wash	Aug. 28	Coaster-gate hoists	McKiernan-Terry Corp., Harrison, N. J	125,352.00
1383	Hungry Horse, Mont	Aug. 5	Construction of streets, sewerage and water systems.	S. Birch & Sons, Great Falls, Mont	401,377.60
1385	Shoshone, Wyo	Aug. 2	Construction, Heart Mountain power plant	Samuels & Franklin Contractors, Gibbons & Reed Co., Denver, Colo.	366,399.00
1390	Boise, Idaho	Aug. 3	Construction, Conway Gulch laterals.	Henry L. Horn, Caldwell, Idaho	170,701.60
1394	Missouri Basin, Mont	Aug. 2	Dismantling and reconstructing buildings	Landon Construction Co., Casper, Wyo	207,739.00
1402	Gila, Ariz	Aug. 3	Construction, "A" canal and "A" laterals	Maceo Construction Co., Clearwater, Calif	254,333.00
1406	Columbia Basin, Wash	Aug. 21	Structural steel for railroad bridge	American Bridge Co., Denver, Colo	10,875.00
1408	Davis Dam, Ariz.-Nev	Aug. 22	25 two-bedroom prefabricated houses	Green Lumber Co., Laurel, Miss	55,000.00
Reg. 6 Spec. 31	Missouri Basin, Mont	Aug. 7	Photo-index maps	Fairchild Aerial Surveys Inc., Los Angeles, Calif	15,742.00

[1] Items 6, 7, 8, 9, 11. [2] Schedules 1, 2. [3] Items 1, 2, 3.

NOTE.—Contracts awarded after Aug. 5, 1946, qualify under the provisions of Office of War Mobilization and Reconversion Directive 128 in that all such contracts are for work on projects commenced prior to that date.

Construction and Supplies for Which Invitations for Bids Will Be Requested During October

Estimated date bids to be invited	Estimated bid opening date	Project	Description or work or material
Oct. 1	Nov. 5	Columbia Basin, Wash	Transformers, etc., for substation.
Oct. 1	Nov. 5	Davis Dam, Ariz.-Nev	Stop log guides.
Oct. 4	Nov. 8	Central Valley, Delta, Calif	Reinforcement bars, Delta-Mendota Canal, station 686 to station 1365.
Oct. 4	Nov. 8	do	Lumber, Delta-Mendota Canal, station 686 to station 1365.
Oct. 5	Nov. 11	Central Valley, Kennett, Calif	Fabrication and erection of aerial tramway.
Oct. 5	Nov. 11	do	Earthwork and structures for tramway terminal facilities and railroad spur.
Oct. 7	Nov. 11	Boise-Payette, Idaho	Clearing part of Cascade Reservoir.
Oct. 8	Nov. 12	Central Valley-Friant, Calif	Reinforcement bars, Friant-Kern Canal, station 1647+75 to station 3876+00.
Oct. 8	Nov. 12	do	Wire fencing, Friant-Kern: Canal, station 1647+75 to station 3876+00.
Oct. 8	Nov. 12	do	Lumber, Friant-Kern Canal, station 1647+75 to station 3876+00.
Oct. 15	Nov. 19	Central Valley-Kennett, Calif	Control cable for Keswick power plant.
Oct. 15	Nov. 19	Boise-Anderson Ranch, Idaho	Reinforcement steel for Anderson Ranch power house.
Oct. 15	Nov. 19	Boise, Idaho	Generator protective equipment for power plant.
Oct. 15	Nov. 19	Boulder Canyon, Nev	Boulder City water supply, transformers and disconnecting switches.
Oct. 15	Nov. 19	Colorado-Big Thompson, Colo	Outlet pipes, Horsetooth Dam.
Oct. 15	Nov. 19	Columbia Basin, Wash	Roof decking for Grand Coulee machine shop.
Oct. 15	Nov. 19	do	Reinforcement steel for Pasco pumping plant.
Oct. 15	Nov. 19	do	Reinforcement steel for Grand Coulee warehouses A and B.
Oct. 15	Nov. 19	do	Reinforcement steel for Grand Coulee pumping plant.
Oct. 15	Nov. 19	do	Reinforcement steel for Grand Coulee machine shop.
Oct. 15	Nov. 19	do	Roof steel for Grand Coulee machine shop.
Oct. 16	Nov. 20	do	Reinforcement bars, Main Canal, station 24+00 to station 436+00.
Oct. 18	Nov. 22	do	Potholes East Canal, station 24+00 to station 436+00.
Oct. 23	Nov. 27	Altus, Okla	Reinforcement bars, Altus Canal, station 610 to station 1147+37.

RECLAMATION AT THE CROSSROADS

(*Continued from page 217*)

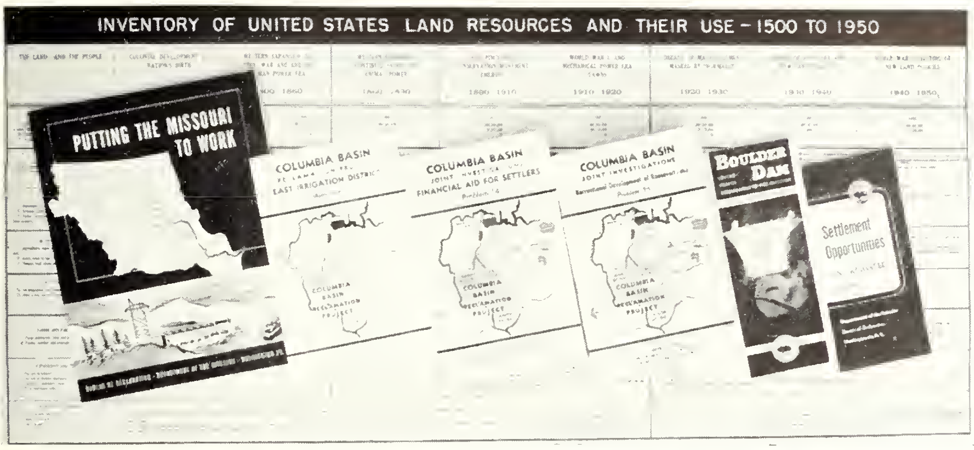
Department will be represented by Lt. Gen. R. A. Wheeler, Chief of Engineers, and Brig. Gen. Lewis A. Pick, United States Engineers' Office, Omaha, Nebr.

The Bureau of Reclamation will also be represented by Assistant Commissioner William E. Warne, former Commissioner Harry W. Bashore, and W. G. Sloan, acting chairman, Missouri Basin Committee of the Department of the Interior.

More News On the President's Directive

In accordance with instructions from the President, the Bureau of Reclamation has submitted to the Budget Bureau its estimates of the construction expenditures necessary to (a) meet commitments made by Reclamation as of August 5, 1946, and (b) to assure a minimum and orderly program for the fiscal year 1947. As this issue goes to press the matter is still under consideration by the Budget Bureau. You will be informed of any new developments in future issues of the ERA.

U. S. GOVERNMENT PRINTING OFFICE: 1946



RECLAMATION'S BOOKSHELF

Recent Bureau Publications

1. *Inventory of United States Land Resources and Their Use—1500 to 1950.*—A chart for wall display and study. To be obtainable soon from the Superintendent of Documents, Washington, D. C.

2. *Columbia Basin Joint Investigations.*—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest reports released are:

Problem 14, *Financial Aid for Settlers*—25 cents.

Problem 26, *Recreational Development of Roosevelt Lake*—75 cents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the East Columbia Basin Irrigation District—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy from the Superintendent of Documents, Washington, D. C.

4. *Maps of Seven States Showing Water Resources Development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to Regional Directors at Regions VI and VII.

5. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy from the Superintendent of Documents, Washington, D. C.

6. *Approved Missouri River Plan Map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

7. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington 25, D. C., or to your Regional Director.

8. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ending June 30, 1945). Obtainable on request to the Bureau of Reclamation as directed above.

9. *Boulder Dam.*—Illustrated folder on the world's highest dam. Obtainable on request to the Bureau of Reclamation at Washington or Boulder City, Nev.

Miscellaneous Publications

History of Legislation and Policy Formation of the Central Valley Project, by Mary Montgomery and Marion Clawson, Bureau of Agricultural Economics, Department of Agriculture, Berkeley, Calif., March 1946; 276 pages (multilithed) with bibliography. A detailed and well-documented history of the Central Valley Project in California. Write the Bureau of Agricultural Economics, Department of Agriculture, Washington 25, D. C.

"National River Basin Policy Needed to Give All Regions Equal Opportunity," by W. C. McNown, Professor of Civil Engineering, University of Kansas, Lawrence, Kans., in *Engineering News-Record*, July 11, 1946, page 107. The author suggests that Congress adopt a policy of fostering Nation-wide river development instead of periodic concentration on a few major streams such as the Missouri or the Columbia.

"Power for Town and Country," by Claude R. Wickard, Administrator, Rural Electrification Administration, in *Public Power*, July–August 1946, page 6. According to Administrator Wickard, "if REA's borrowers are to make their full contribution to the Nation's welfare they must be assured of access to adequate supplies of power to serve all consumers at rates consumers can afford to pay."

Motion Pictures

The Bureau of Reclamation distributes 16 mm. motion pictures relating to its activities. The films will be loaned the borrower willing to pay the express charges both ways. The list follows:

(Distributed from the Bureau of Reclamation Office, Washington 25, D. C.)

Boulder Dam	5 reels	(silent)
Boulder Dam	4 reels	(sound)
Reclamation in the Arid West	1 reel	(sound)
Fundamentals of Irrigation	3 reels	(sound)
Irrigated Pastures (Kodachrome)	2 reels	(sound)
Fighting Weeds (Kodachrome)	3 reels	(sound)
Measurement of Water (Kodachrome)	3 reels	(sound)

For Your Art Collection

Write to the Bureau of Reclamation, Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue.*

CONTACT PRINTS single weight glossy paper, (available only if size of negative permits):

	Selling price (each)
4 x 5 (or smaller)	$0.15
5 x 7	.20
8 x 10	.40
ENLARGEMENTS:	
4 x 5 (or smaller) single weight glossy	.25
5 x 7 single weight glossy	.40
8 x 10 single weight glossy	.60
11 x 14 single weight glossy	1.25
11 x 14 double weight mat	1.50
16 x 20 double weight mat	2.50
20 x 24 double weight mat	3.00
24 x 30 double weight mat	5.00
24 x 36 double weight mat	6.00
30 x 40 double weight mat	8.00
	Per sq. ft.
Over 30 x 40 double weight mat	$0.85

Recent Project Maps

Published by the Bureau of Reclamation

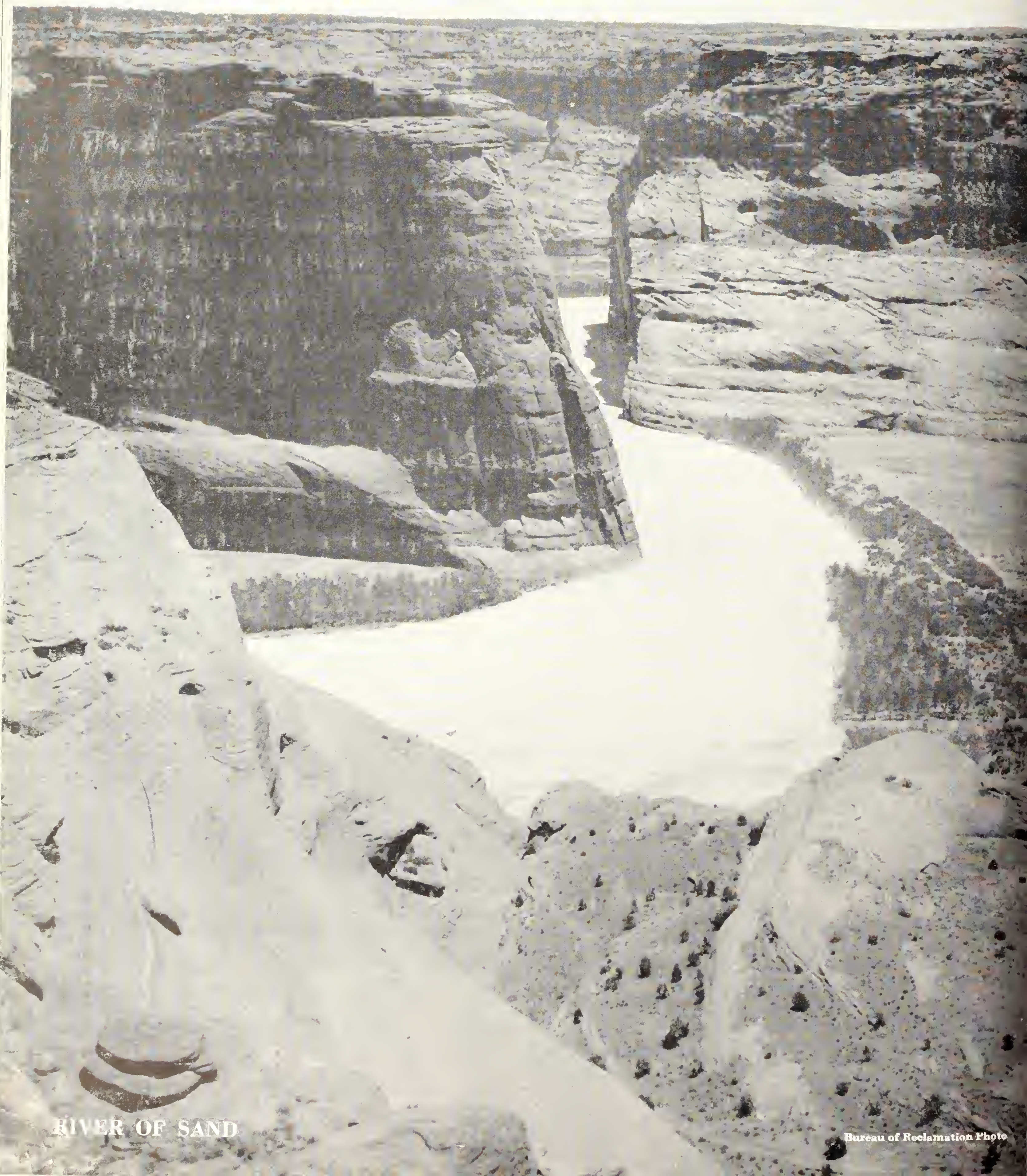
Western half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 x 20 inches, FREE.

Orland project, California. Map No. 45–45, (supersedes No. 21880). Blue, green, and black. Size 8 x 10½ inches, price 10 cents.

Grand Valley project, Colorado. Map No. 45–40, (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 x 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52 (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 x 20 inches, price 25 cents.

Note.—In ordering maps, or photographs, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States and address your order to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.


RIVER OF SAND
Bureau of Reclamation Photo

OVEMBER
1946

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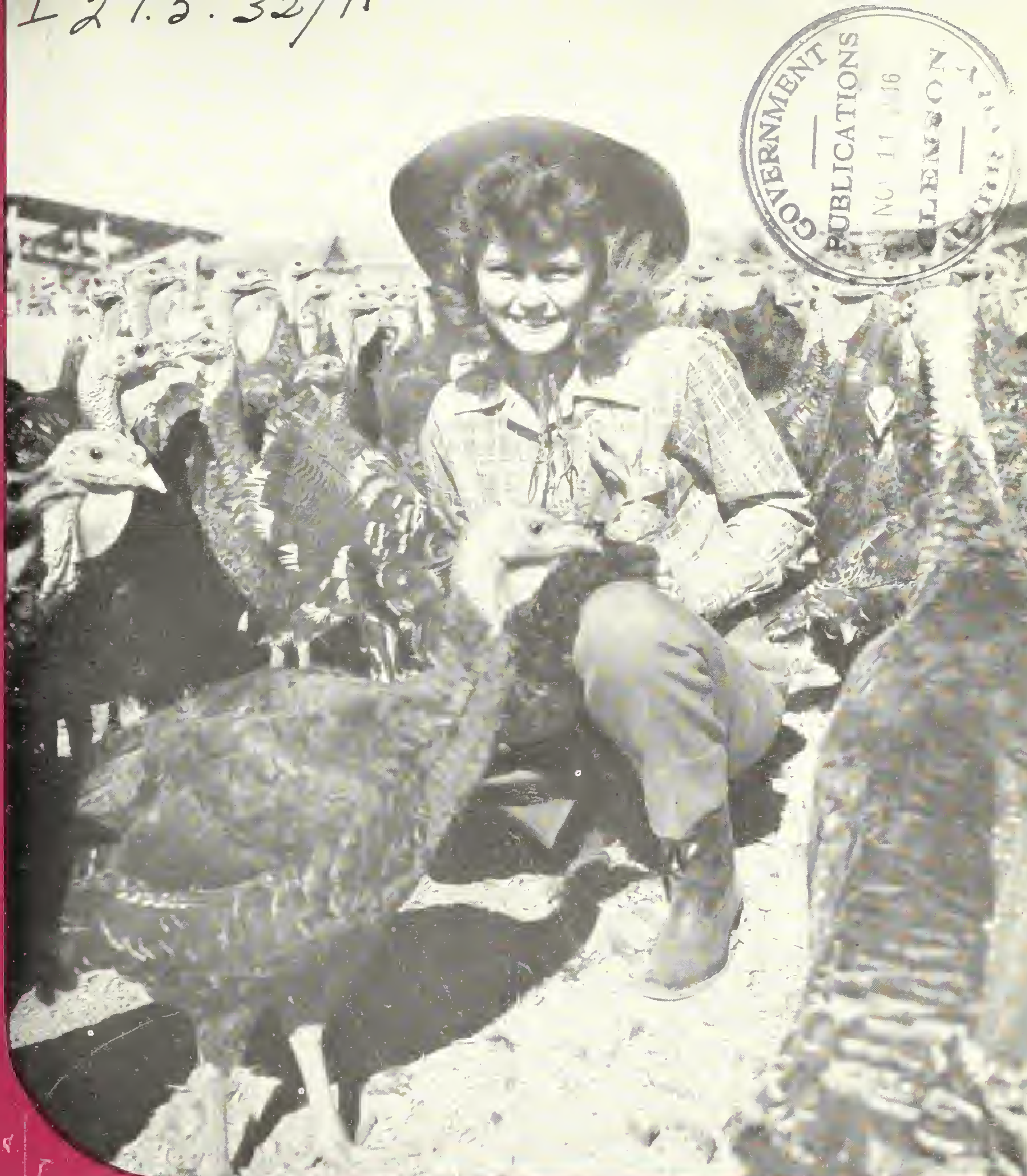
In This Issue:

BOULDER: *Ten-Year-Old King of Power*

LKING TURKEY

PUMPING FOR PROSPERITY



THE *Reclamation* ERA

Photograph by Dale Hovey, Region V

Our Front Cover

A BIRD IN THE HAND . . . In Colfax County, N. Mex., more than two-thirds of the State's turkey crop is raised. Mrs. Buzz Sherritt, wife of one of the two Sherritt brothers who operate the Maxwell turkey farm, poses with potential Thanksgiving fare. The delicious dinners these birds will make were once to be had only in the East, especially New England. Today, the original Thanksgiving dinner has become equally available in the West, as a result of irrigated farms.

Single Copies of the *ERA* Available

For the benefit of our subscribers and others who would like to purchase individual copies of particular issues of the RECLAMATION ERA, the following rates have been established:

	Cents
1 copy	15
6 to 9 copies	12
10 to 50 copies	10
50 or more copies	8

A limited number of copies of the May, June, July, and August 1946 issues are now available.

Make out check or money order to the TREASURER OF THE UNITED STATES and send request to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Please do not send stamps. For small orders, coins will be accepted.

Published by the Bureau of Reclamation, Department of the Interior, Washington 25, D. C. Publication approved by the Bureau of the Budget. Subscription rates, $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

Reclamation ERA

Vol. 32 NOVEMBER 1946 No. 11

Contents

THE WHITE HOUSE
WASHINGTON

October 1, 1946

Dear Judge Sawyer:

Please extend my greetings and best wishes to the National Reclamation Association at its convention in Omaha.

In my Message to the Congress in September 1945, I said that "Favorable consideration should be given by the Congress to Federal reclamation projects as outstanding opportunities for returning veterans." In January 1946, I asserted that "The strength of our Nation and the welfare of the people rest upon the natural resources of the country." In an effort to make up for time lost during the war through curtailment of construction and long-range planning of resource development, I then presented to the Congress for the fiscal year 1947 the largest annual budget estimate in the history of Federal Reclamation.

Urgent needs of veteran housing and hospitals, together with other factors, have forced retarding full-scale resumption of all public works, but Reclamation construction will be pressed as rapidly as circumstances allow. More than ten million of our western people live in areas to be served by irrigation, power, and municipal water developments in the authorized Reclamation program and the widespread demand for its completion is recognized.

My particular concern is that new and supplemental irrigation shall be extended to increase the number of family-size farms for veteran settlement and to provide for the expanding population of the West. Full advantage must also be taken of hydroelectric developments to give financial assistance to irrigation and to transmission systems to carry power to new industries, farms, and urban areas.

The Bureau of Reclamation has been a mighty force in the mobilization of western water and land resources. Its program of river basin development looks to even greater service to the West and the Nation.

Very sincerely yours,

Harry Truman

Hon. Robert W. Sawyer,
President,
National Reclamation Association,
Bend, Oregon.

Letters to the Editor

New Zealand Speaks

SEPTEMBER 5, 1946.

DEAR EDITOR:

Mr. Corfitzen's able article in your May issue—"Ideas Go Travelling"—prompts comment and also an expression of appreciation from a New Zealander.

As a civil engineer of the public works department, seconded to the New Zealand Supply Mission in Washington, D. C., it has been my privilege during the past 2½ years to have close association with a number of officers of the Bureau. Those associations could not possibly have been more pleasant—nor could they, I believe, have been more fruitful. I would add that similar comment has unreservedly been offered by other New Zealanders who have had the opportunity of visiting Bureau offices and projects.

Mr. Corfitzen refers to the Bureau's belief that scientific knowledge pertaining to Reclamation projects should be the subject of mutual exchange between Allied countries. With that ideal the New Zealand Government departments concerned are certainly in full accord. Thus far—and no doubt inevitably—the reciprocation of technical data between the United States and New Zealand has been a somewhat one-sided transaction. I am, however, glad to offer the assurance that New Zealand engineers are well aware of their technical indebtedness to this country. They will, I am sure, be continually mindful of the fact that a number of United States engineers will be interested in the presentation of data defining New Zealand hydroelectric and irrigation projects; and I believe that every effort will be made to satisfy that expressed interest.

Sincerely,

HUGH A. FULLARTON,
Technical Advisor,
New Zealand Supply Mission,
Washington, D. C.

South American Way

AUGUST 8, 1946.

The May issue of the RECLAMATION ERA . . . just arrived. Very interesting, showing the Bureau's new organization and giving notice of the great plans and projects of irrigation and "basin control." . . . With best wishes. . . .

Professor R. E. BALLESTER,
Buenos Aires, Argentina.

Recordings Available

Electrical transcriptions of significant speeches given by Department of the Interior officials at the Fifteenth Annual Convention of the National Reclamation Association, Omaha, Nebr., on October 9–11, are available for scheduling on your local radio station by writing to the Bureau of Reclamation in Washington, D. C., or your nearest regional director.

One 15-minute program features Warner W. Gardner, Assistant Secretary, Department of the Interior, giving highlights from his speech, "Reclamation as a National Investment," Michael W. Straus, Commissioner, Bureau of Reclamation, on "Reclamation—Where Do We Go From Here?" and William E. Warne, Assistant Commissioner, Bureau of Reclamation, on "The Development of the Colorado River Basin." This transcription runs 11 minutes and 30 seconds, which allows ample time for your local radio station announcer to present local facts pertaining to the program.

A separate transcription of Mr. Warne's address, "The Development of the Colorado River Basin," has been made, which runs 12 minutes, allowing a local tie-in.

For Your Art Collection

Write to the Bureau of Reclamation, Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue.*

	Selling price (each)
CONTACT PRINTS (single eight glossy paper, available only if size of negative permits):	
4 x 5 (or smaller)	$0.15
5 x 7	.20
8 x 10	.40
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5 x 7 single weight glossy	.40
8 x 10 single weight glossy	.60
11 x 14 single weight glossy	1.25
11 x 14 double weight mat	1.50
16 x 20 double weight mat	2.50
20 x 24 double weight mat	3.00
24 x 30 double weight mat	5.00
24 x 36 double weight mat	6.00
30 x 40 double weight mat	8.00
	Per sq. ft.
Over 30 x 40 double weight mat	$0.85

Recent Project Maps

Published by the Bureau of Reclamation

Western half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 x 20 inches, FREE.

Orland project, California. Map No. 45–45, (supersedes No. 21880). Blue, green, and black. Size 8 x 10½ inches, price 10 cents.

Grand Valley project, Colorado. Map No. 45–40, (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 x 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52, (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 x 20 inches, price 25 cents.

**Note.*—In ordering maps, or photographs, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States and address your order to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

Motion Picture—Alva B. Adams Tunnel

"Driving the Alva B. Adams Tunnel" (running time 20 minutes), available for free showing upon request to the Film Bureau of Ingersoll-Rand Co., Phillipsburg, N. J. This 16-mm. film shows the driving of a 13-mile tunnel through the Continental Divide in Colorado in order to permit diversion of water from the western slope to the plains on the eastern side of the range where a large share of the Nation's sugar beets is raised.

The Alva B. Adams Tunnel is the key structure of the Colorado-Big Thompson project of the Bureau of Reclamation. It will bring additional water to 610,000 acres of farm and generate electric power as a byproduct of that service. The picture—a revision of one released 2 years ago—shows details of the tunneling procedure more vividly than could have been seen on the job itself. The film is designed to interest both technical and nontechnical audiences.

Motion Pictures

The Bureau of Reclamation distributes 16 mm. motion pictures relating to its activities. The films will be loaned the borrower willing to pay the express charges both ways. The list follows:

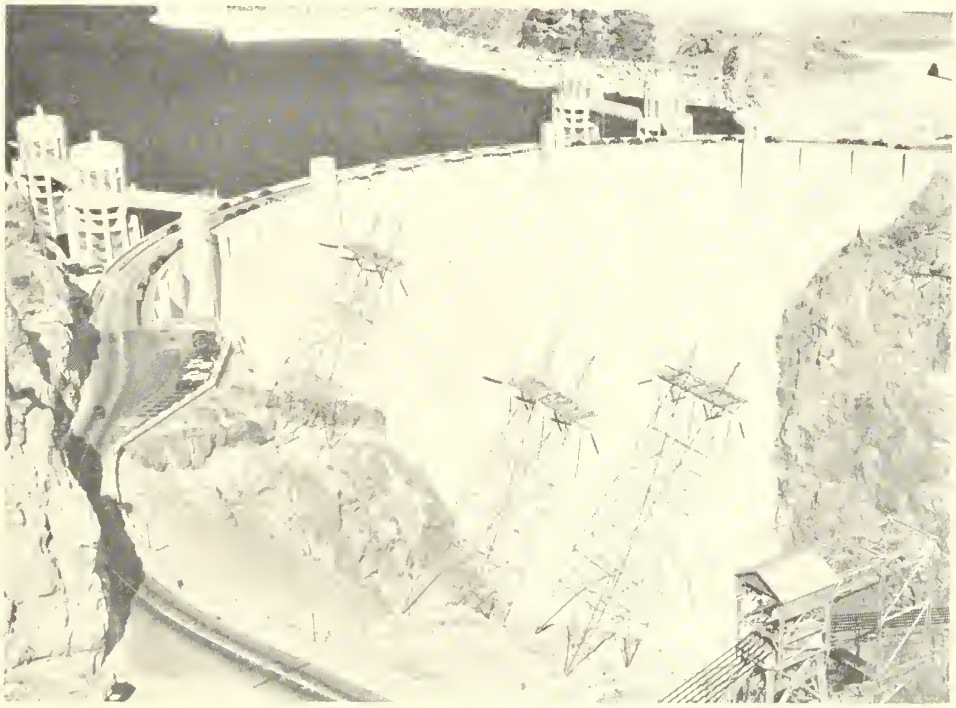
(Distributed from the Bureau of Reclamation Office, Washington 25, D. C.)

Boulder Dam	5 reels	(silent)
Boulder Dam	4 reels	(sound)
Reclamation in the Arid West	1 reel	(sound)
Fundamentals of Irrigation	3 reels	(sound)
Irrigated Pastures (Kodachrome)	2 reels	(sound)
Fighting Weeds (Kodachrome)	3 reels	(sound)
Measurement of Water (Kodachrome)	3 reels	(sound)

BOULDER: *Ten-Year-Old King of Power*

by C. A. RYDELL, Boulder Canyon Project, Region III, Boulder City, Nev.

This year marks the tenth anniversary of power generation at Boulder Dam. It was on September 11, 1936, that the late President Franklin D. Roosevelt, at the conclusion of his address to the Third World Power Conference meeting in Washington, D. C., turned a golden key which started the first generator at Boulder Dam. A few weeks later, in October, the first delivery of electric energy was effected to Los Angeles. By the end of that month, regular electrical service had begun to the coastal region of southern California. Since that time the generators in the Boulder plant—the largest of its kind in the world—have turned ceaselessly: producing the energy which has flowed in a constant stream to the growing industries of the great Southwest.



The leaning towers of Boulder.

It is only a short time, as years are numbered, since this event occurred. Yet in the period intervening, an era has ended and a new age has begun.

In no section of the Nation has progress been more rapid during the past decade, nor production records more significant, than in the Southwest. The cities of Los Angeles and San Diego, Calif., and Phoenix, Ariz., have taken their places as leaders in the Nation's industrial picture. During this period, population in the Southwest has increased 13 percent. In some areas the growth has been sensational. Las Vegas, Nev., with a population of 8,000 in 1940 more than trebled and had an estimated population of 25,000 in 1945.

Much of this growth and expansion—particularly in the field of industry—was predicated on the availability of power—low-cost power, and power in huge quantities.

In the 10 years since it began generating electricity, Boulder Dam power plant has contributed immensely to this development of the Southwest; to the successful prosecution of the war, and now affords added potentialities in the Southwest of the future.

The alleviation of the power shortage at rapidly growing Phoenix, Ariz., through transmission lines constructed from Boulder plant to that city; the use of one-fourth the entire output of Boulder at the basic magnesium plant on the desert near Boulder City, Nev.; the conservation of America's oil resources made possible through Boulder's hydroelectric power, the 1943 record of supplying more than half of all the electric energy used in the Los Angeles area; Boulder's role in developing mineral production throughout the Southwest to meet wartime needs—all these and many other facts confirm our growing respect for a tried and true veteran—Boulder Dam.

Now that the war is over, this giant Reclamation project is ready to send its power to mine, farm and factory.

But, while we salute production of power at Boulder Dam, it would be a gross error to overlook the primary objectives of the Boulder Canyon project. It should be stressed that Boulder Dam was conceived and designed by engineers of the Bureau of Reclamation primarily to prevent damage from floods, to regulate the flow of the unruly Colorado, and to store water for irrigation and domestic uses. For centuries the inhabitants of the fertile valleys of southern California and southwestern Arizona had lived in fear of being destroyed by flood waters of this erratic stream. Each year, after the flood season had passed, the people were faced with drought. It was to alleviate this condition that Boulder Dam was built. And it has fulfilled its major purposes. While the floods of the past 10 years have been trapped in Lake Mead, the water thus stored has become available during the dry season to sustain growing crops. No longer do the farmers live in fear of flood seasons followed by drought. And while the factories in the cities were turning out equipment for our fighting forces, the farmers in the irrigated areas of southern California and Arizona were producing desperately-needed food. In the year 1944 foodstuffs valued at nearly 70 million dollars were produced on land irrigated by water from the Colorado River. In terms of commodities this value represents trainloads of produce: tomatoes, lettuce, eggplant, cantaloupes, and other garden truck; fruit, such as citrus and dates; hundreds of thousands of tons of alfalfa for the feeding pens and the dairies; seeds, such as alfalfa and flax; and miscellaneous crops, such as sugar beets, cotton and rice. And the year 1944 was not an exceptional year, for this production record can be expected to continue as long as there is protection from floods and regulation of the river's flow.

Corralling the Colorado, Part III

BY WILLIAM E. WARNE

Assistant Commissioner of Reclamation

From the time of the cliff-dwellers right on down to today, men who have chosen to live in the Colorado Basin have had to irrigate land to provide food for themselves. Our irrigation methods have improved over those of the prehistoric Indian who carried the water to his corn hills in an olla on his head, but in the Colorado River Basin men have irrigated the land or moved on. Red men or white men, pagan or Christian, Mormon or Catholic, Spanish, Mexican, or American, irrigated the land or got out.

In the future, also, the number of Americans who can live in the Colorado River Basin will have a direct relationship to the amount of water used there for irrigation.

In 1869, the new attitude that the Colorado River must be used was held by Maj. John Wesley Powell when he headed the first successful exploration of the canyon sections of the river. The names of others who made important studies of the river, C. H. Birdseye, A. P. Davis, F. E. Weymouth, Walker R. Young, E. C. La Rue, come to mind, but there were none more colorful than the one-armed Civil War veteran, Major Powell, who sat in a chair bolted to the deck of a boat as he ran the rapids of the river. Powell lived to preach water conservation and to influence the making of the Reclamation law that has been so beneficial in the development of the Colorado River.

The Colorado River was too big a problem for one man, agency, or State to handle alone. Cooperation was required among all interests to achieve the results these studies foretold.

By 1920, the Governors of the 7 States of the basin were organizing meetings to plan joint action. In that year, at one of the meetings, Delph E. Carpenter of Colorado made the novel proposal that Wyoming, Utah, Colorado, New Mexico, Nevada, California, and Arizona, all being sovereign States, exercise the treaty-making powers reserved in the Federal Constitution as a means of cementing an agreement on the interstate division of the waters of the Colorado River.

Carpenter's key of complete cooperation

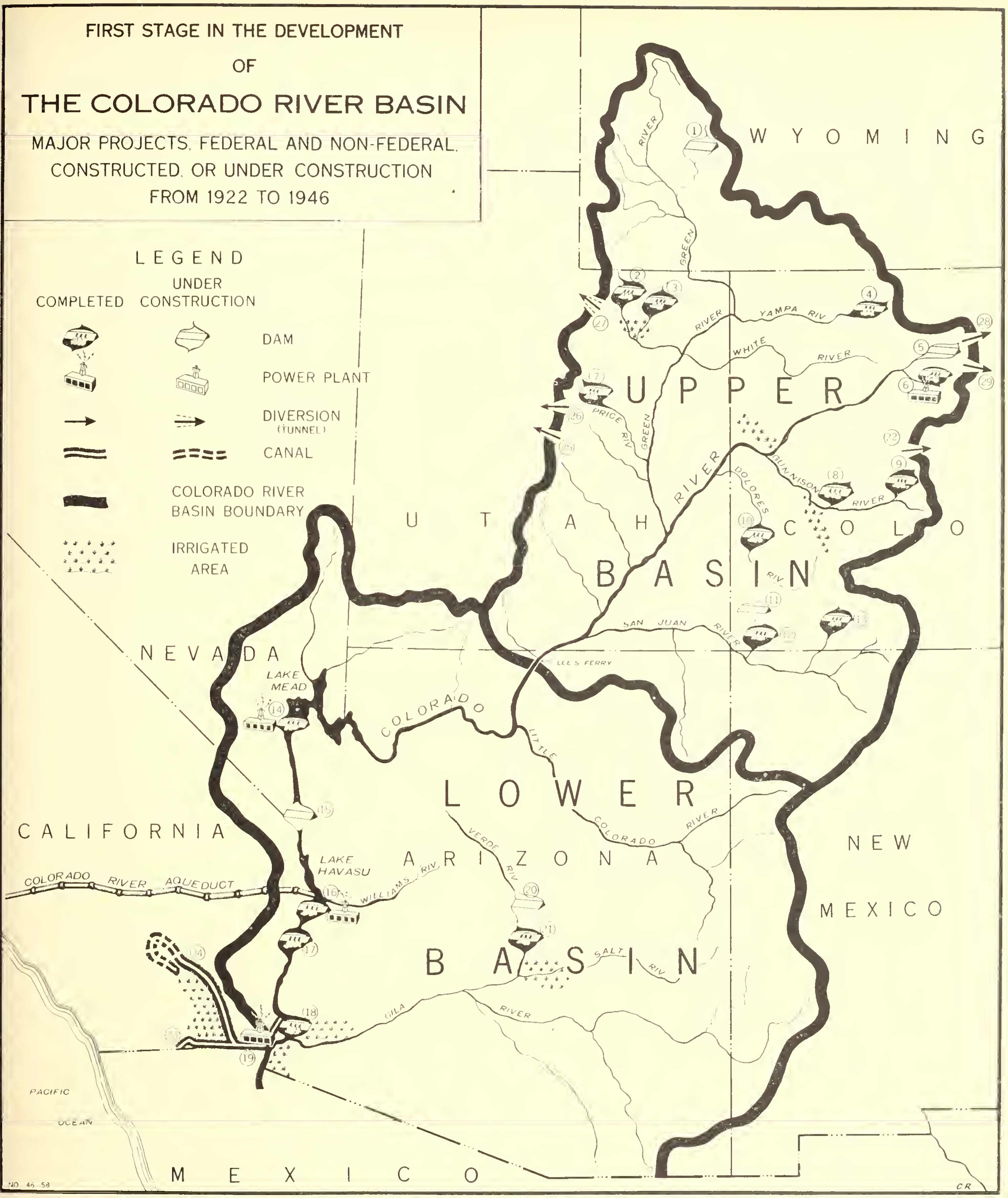
"PROFITLESS LOCALITY"—Sketch made of the Black Canyon in 1857 by Lieutenant Ives. Believed to represent the site on which the present Boulder Dam was built.

unlocked the puzzle that the interstate character of the river presented. In Santa Fe on November 24, 1922, the Colorado River Compact was completed. This then unique interstate treaty divided the waters of the Colorado River system between the upper and the lower basins at Lee Ferry, by providing that each basin could have the beneficial consumptive use of 7,500,000 acre-feet of water annually, that the lower basin could increase its beneficial consumptive use of such water annually, and that the States of Colorado, New Mexico, Utah, and Wyoming will not deplete the flow of the river at Lee Ferry below an aggregate of 75,000,000 acre-feet during any period of 10 consecutive years. This compact has been scrutinized microscopically and there are many opinions concerning some of its provisions. But the compact has borne as fruit the Boulder Canyon project and the entire first state of development of the Colorado River.

Made possible by the compact was the construction of Boulder, Davis, Parker, and Imperial Dams, of the All-American Cana[l], the Colorado River aqueduct servin[g] southern California cities, and of new irrigation projects such as the Gila and th[e] Colorado-Big Thompson.

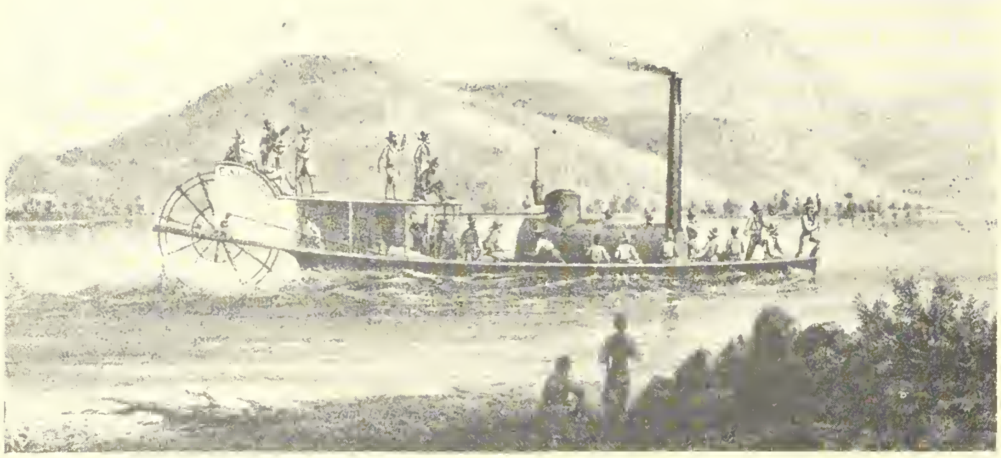
Among other results of the compact wa[s] legislation authorizing and directing th[e] Bureau of Reclamation to make studies an[d] prepare a comprehensive plan for furthe[r] development of the Colorado River Basin. A few months ago, after years of work i[n] close cooperation with the States and othe[r] agencies, the Bureau of Reclamation presented to Secretary of the Interior J. A. Krug, a comprehensive report on the development of the water resources of th[e] Colorado River Basin for irrigation, powe[r] production, and other beneficial uses. Thi[s] report, entitled "The Colorado River," ca[n] now be obtained by writing to the regiona[l] directors of the Bureau of Reclamation a[t] Boulder City, Nev., and Salt Lake City, Utah.

What can be considered as the secon[d] stage of development of the basin? Th[e] report shows that not quite half of the wate[r] of the Colorado River is used now. It show[s] that there are 134 potential projects worth[y] of consideration at this time in connectio[n] with the second stage of development. O[f] these projects, 100 are in the upper basi[n] where the lesser development occurred during the first stage. The 134 projects woul[d] irrigate 2,656,230 acres of land that are no[w] dry or inadequately watered, 1,734,98[0] above Lee Ferry and 921,250 below. O[f] this total, 1,533,960 acres would be land[s] never before cultivated. The report furthe[r] shows that, in addition, 500,000 acre-feet o[f] water have been allowed for irrigation o[f] upland pasture for use in connection wit[h] grazing both in national forests and on othe[r] public lands. The report shows that 3[?] hydroelectric power plants with a total installed capacity of more than 3,500,000 kilowatts are possible as a part of the development program. The report notes opportunities to usefully divert water for use i[n] other adjacent basins. The report reemphasizes the fact, however, that there are mor[e] opportunities to use water in the great Colorado Basin than can be supplied by th[e]



Key to numbered symbols in map above. Symbols are not drawn to scale.

1. Big Sandy Dam, Wyo.
2. Midview Dam, Utah
3. Moon Lake Dam, Utah
4. Stillwater Dam, Colo.
5. Granby Dam, Colo.
6. Green Mountain Dam and Power Plant, Colo.
7. Scofield Dam, Utah
8. Fruit Growers Dam, Colo.
9. Taylor Park Dam, Colo.
10. Groundhog Dam, Colo.
11. Jackson Gulch Dam, Colo.
12. Narraguinnep Dam, Colo.
13. Vallecito Dam, Colo.
14. Boulder Dam and Power Plant, Ariz.-Nev.
15. Davis Dam, Ariz.-Nev.
16. Parker Dam and Power Plant, Ariz.-Calif.
17. Headgate Rock Diversion Dam
18. Imperial Dam
19. Siphon Drop, and Drops Nos. 3 and 4 Power Plants, Calif.
20. Horseshoe Dam, Ariz.
21. Bartlett Dam, Ariz.
22. Twin Lakes Extension Tunnel, Colo.
23. All-American Canal System, Ariz.-Calif.
24. Coachella Branch, All-American Canal System, Calif.
25. Ephraim Tunnel, Utah
26. Spring City Tunnel, Utah
27. Duchesne Tunnel, Utah
28. Alva B. Adams Tunnel, Colo.
29. Moffat Tunnel, Colo.



STEAMBOAT ON THE COLORADO—Lieutenant Ives traveling up from the mouth of the Colorado River to Black Canyon.

reliable annual water yield of the Colorado River.

This again brings the entire basin squarely face to face with the problem that confronted the seven States back in 1920. Further cooperation is required or development is likely to be suspended for 10 or 20 years—if it is not permanently stopped at this point. The question is: What water will be used where, in the further development of the Colorado River Basin?

This time, however, there are guide posts to aid in the working out of a mutual program, which should make the task easier. For example, there is the Colorado River Compact, and the Mexican Water Treaty that was ratified in 1945. These set the amounts of water required for delivery at two critical points, Lee Ferry, the dividing point of the upper and lower basins, and the Mexican border, below which the river is out of the reach and jurisdiction of the United States. This treaty, which provides that Mexico shall acquire no right to the waters of the river in excess of 1,500,000 acre-feet of water a year, serves to remove a major uncertainty that previously had faced those who were at work developing the basin: namely, the limit of Mexico's right. This had to be done before the division and use of waters on the Unite States' side safely could be carried muc further. Another advantage we have toda is that we have a tried and proven metho of negotiating and confirming interstat water agreements.

The Secretary of the Interior, actin through Reclamation Commissione Michael W. Straus and in accordance wit the recommendation of Regional Directoı E. O. Larson (region IV) and E. A. Morit (region III), joint authors of the compre hensive report, has asked the basin States t determine their respective rights to deplet the flow of the Colorado River consister with the Colorado River Compact. He ha asked also for the recommendations of th seven States for construction of projects i the next stage of development, the strear flow depletions of which will assuredly fa within the ultimate allocations of the wate which may be made to the individual States Secretary Krug had thus to turn to th States.

The Reclamation Law now provides an always has provided that the Departmen shall proceed in uniformity with State law regarding water rights. The Flood Contro Act of 1944 requires that Reclamation plan be laid before the affected States in orde that they may comment to us and througl us to the Congress on the soundness and de sirability of the works and scheme proposed.

The challenge to cooperate and to pro ceed with the development of the Colorad Basin was quickly accepted.

THE COLORADO RIVER COMMISSION AND ADVISERS AT BISHOP'S LODGE, SANTA FE, N. MEX., IN 1922

Left to right: W. S. Norviel, commissioner for Arizona; Arthur P. Davis, Director, Reclamation Service; Ottamar Hamele, chief counsel, Reclamation Service; Herber Hoover, Secretary of Commerce and Chairman of Commission; Clarence C. Stetson, executive secretary of Commission; L. Ward Bannister, attorney, of Colorado Richard E. Sloan, attorney, of Arizona; Edward Clarke, commissioner for Nevada; C. P. Squires, commissioner for Nevada; James R. Scrugham, commissioner fo Nevada; William F. Mills, former Mayor of Denver; R. E. Caldwell, commissioner for Utah; W. F. McClure, commissioner for California; R. F. McKisick, deput attorney general of California; Delph E. Carpenter, commissioner for Colorado; R. J. Meeker, assistant State engineer of Colorado; Stephen B. Davis, Jr., commissione for New Mexico; J. S. Nickerson, president, Imperial irrigation district of California; Frank C. Emerson, commissioner for Wyoming; Charles May, State engineer o New Mexico; Merritt C. Mechem, Governor of New Mexico; T. C. Yeager, attorney for Coachella Valley irrigation district of California.

Governors Hunt of Wyoming, Vivian of Colorado, Maw of Utah, and Dempsey of New Mexico, met in Cheyenne July 22, 1946, with Federal Commissioner Harry W. Bashore, representing President Truman, to organize for negotiation of a compact regarding the waters of the upper basin. Arizona, which has some interests in the upper basin, was represented. Several meetings have since been held of the Compact Commission and its engineering committee. Conscientious men are earnestly at work and there is every possibility that they will be able to eliminate perhaps the biggest uncertainty in the basin today—namely the question of dividing the upper basin waters.

The old committee of 16, having two representatives from each basin State and two of the power allottees at Boulder Dam (representatives of the department of water and power, city of Los Angeles, and the metropolitan water district of southern California), has been succeeded by the Colorado River Basin States Committee. This group, or at least a large part of it, has met and will continue to meet in the interests of promoting a mutual plan for the development of the entire Colorado River Basin. Other groups are similarly engaged. The Bureau of Reclamation is working with all of these groups with the avowed purpose of aiding and assisting in the development of the specifics of a plan for the second stage of development of the basin.

The Governor of each of the seven States has assigned to responsible men of his staff, in addition, the task of reviewing and commenting on the comprehensive report. Because of the size and scope of the report, the Department will withhold it from submission to the Congress 90 days longer than required by law so that the States will have more time for review and comment.

The stakes for which all are playing in this game of "get together" are extremely high. If there is developed a mutually agreeable plan as a result of the work now under way in the States, a plan that might well involve the construction of a billion dollars or more of projects for irrigation, power, river regulation, and related purposes, we believe that such a plan can be justified before the American people, authorized for construction as the second stage, and financed by the Congress. In this event the projects could be constructed in the near future and put to use. This second stage will occupy the construction forces for perhaps another 15 or 20 years, as the first stage has occupied the construction forces for the past 15 or 20 years, but it will not exhaust either the water or the possibilities of the Colorado River Basin.

MOTORBOAT IN THE CANYON—Congressional party visiting the Black Canyon on March 13, 1923, at the lower damsite.

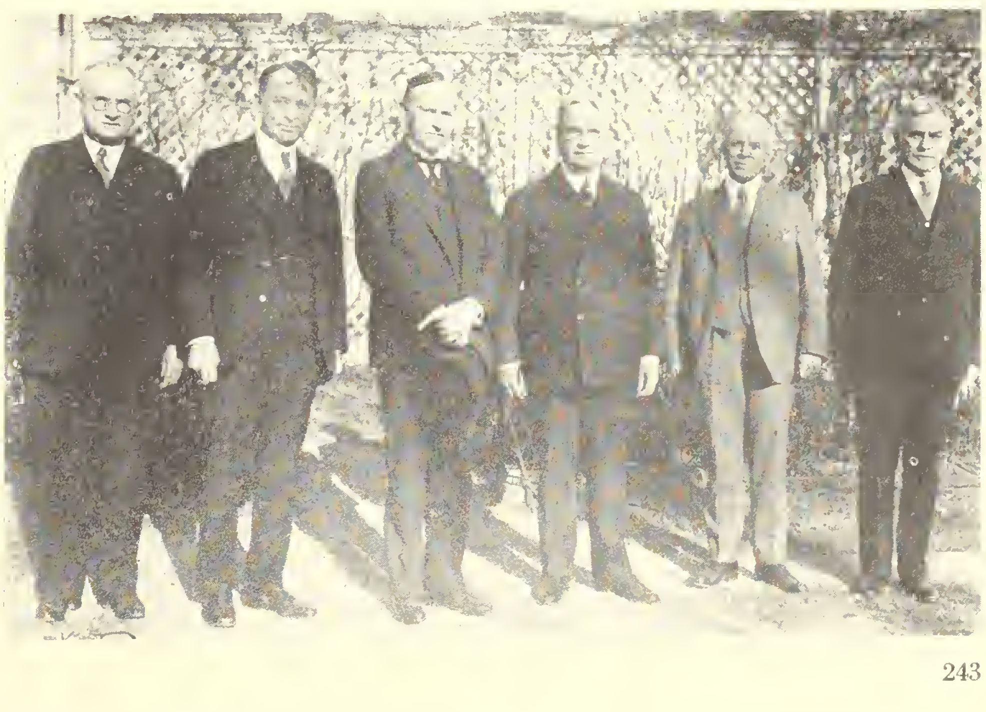
The development of the Colorado River Basin to the point at which the last drop of water that can be provided will be put to beneficial use is 100 years away and perhaps much farther. There will be unused water in the Colorado River to waste into the sea for perhaps another century, long after any sensible and justifiable second stage of development is completed and put to use.

At this moment, the principal danger in the Colorado River situation is that the fine tradition of agreement and mutual effort that has served the seven basin States so well in the past may be abandoned because of fear. Some who are interested in developments that have already been made fear that water they hope to use may be committed elsewhere in the second stage of development. This fear is wholly groundless. The second stage of development cannot and should not be a 100-year plan; it should be a

(Continued on page 256)

THE FATHERS OF BOULDER DAM

Left to Right: The late Dr. Elwood Mead, former Commissioner of Reclamation, Hon. Phillip D. Swing, co-author of the Swing-Johnson bill which authorized construction of the Dam, the late President Calvin Coolidge, the late Senator Hiram W. Johnson, Hon. Addision T. Smith, former Chairman of the House Committee on Irrigation and Reclamation, and the late W. B. Mathews.



IT WORKS BOTH WAYS

CHINESE ENGINEERS IN AMERICA

By William E. Corfitzen, *Chief, Special Assignments Section*

On the projects, in the laboratories, and at drafting desks of the Bureau of Reclamation you may find today many Chinese and other foreign engineers who have come thousands of miles to spend long periods grasping the methods of American technology.

The top cut of the world's young engineering graduates are coming to the United States for training in American "know-how" under the sponsorship of the International Training Administration, Inc., industry, and their own governments.

From Ecuador and Peru, from China and Chile, from countries way down under and half way around the globe, they come to the United States for a year's cramming in American standards and techniques before plunging into the task of industrializing and rehabilitating their own countries.

Notable among many foreign engineer internes who have taken their advanced training in the Bureau of Reclamation is a group of 25 Chinese who were recently awarded certificates of merit by the Commissioner of Reclamation Michael W. Straus upon completion of their year's tour.

Upon receiving his certificate at a luncheon tendered by more than 100 Bureau of Reclamation employees, the spokesman for the Chinese, Chung-Yu Pan, declared that "the Bureau's success in spectacular and revolutionary dam-building projects has not only changed the viewpoint of the whole engineering world, but has also started a new era of engineering yardsticks and economy. Engineering organizations throughout the world are fascinated and inspired by the success of the Bureau, and find new courage to face similar or even greater challenges of nature. The Bureau has become the international center of advance engineering education."

The foreign engineers who come to the Bureau of Reclamation for training have survived a rigorous weeding-out process as only a few are selected from the thousands competing for the opportunity. The expenses of their training are borne by their own governments. They are selected and supervised by the International Training Administration, Inc., a private nonprofit institution formed from the Inter-American Trade Scholarship Program originally established under the Office of Inter-American Affairs in August 1941. This service institution with a board of directors representative of government, management, and labor, does not itself provide actual training or finances. All requests for the training of foreign engineers come to the Bureau of Reclamation from the State Department which maintains close cooperation with ITA.

To provide for incidental expenses incurred in training or in caring for distin-

guished foreign visitors, the Interdepartmental Committee on Scientific and Cultural Cooperation approved an allotment of $1,750 to the Bureau of Reclamation.

Foreign engineer training is not a one-way street. Certain Norwegian engineers who came to study in the Bureau of Reclamation a short time ago, brought with them details of revolutionary designs for lightweight structures that would impound huge reservoirs with minimum use of steel and concrete. The Norwegians had developed them to meet requirements of construction high in the mountains where access roads were not feasible and materials had to be flown in by air and dropped on the site.

Speaking of the role of foreign training before the fifth anniversary dinner of ITA, a Department of Commerce official said:

"Never in history has there been a time when an exchange of information was more needed. A large part of the world lies prostrate in the ruins of war, and the United States is practically the only country whose industrial and educational plants are intact and able to advance technological development without long delays.

Before VJ-day—two or three miles from the Japanese lines, John L. Savage swaps engineering data with Chinese engineers.

AMERICAN ENGINEERS IN CHINA

While Chinese engineers are enjoying the advantages of American training, American engineers are gaining priceless scientific experience in China. The "billion dollar engineer" John L. Savage has added to his reputation as an international expert on engineering science through his participation in plans for the Yangtze River Basin development. He is expected to arrive in China around the middle of this month. Another American engineer, formerly the senior engineer of the San Francisco regional office, Federal Power Commission, John S. Cotton, is now in China under direct contract as chief engineer of the National Hydro-Electric Engineering Bureau. The Morrison-Knudsen Co., Inc., of San Francisco, Calif., has a contract with the Chinese Government for the Yangtze exploration program and has sent R. E. Selby, along with several assistants, including three diamond drillers, to China. Mr. Selby will be Morrison-Knudsen's superintendent of the exploration program. Fifteen additional men, mostly drillers, will be sent later and men and equipment are expected to be on the site about the first of this month.

Mr. W. C. Beatty, former chief mechanical engineer of the Bureau of Reclamation's Denver, Colo., office, has a contract with the Chinese Government as consulting engineer on mechanical features of the Yangtze development. Now retired from Bureau service, he will work in Denver in this consulting capacity.

Mr. Leon Eliel, vice president of the Fairchild Aerial Surveys, Inc., Los Angeles, Calif., returned from China in August after obtaining limited aerial topographic maps. The Chinese Government and Fairchild Co. are now negotiating a contract for an aerial topographic survey of the Yangtze Basin.

As a still further example of international cooperation along reclamation lines, there is Fred O. Jones, Columbia Basin project geologist, and author of a forthcoming book entitled, "Coulee From Hell to Breakfast," who will write the next chapter of his own life story in China.

He has signed a 2-year contract with the Chinese Government to supervise geological investigations for its great Yangtze Gorge Dam, and left the United States Sept. 10.

Only 34 years old, Jones was recommended for the important assignment by Dr. John L. Savage, world-famous designing engineer and long-time chief designing engineer for the Bureau of Reclamation. Under the National Hydro-Electric Engineering Bureau of China's National Resources Commission, Jones will direct Chinese geologists and engineering assistants in testing the limestone bedrock to determine the exact location of the river barrier.

"The dam site is near Ichang, approximately 1,000 miles up the Yangtze," Jones said in an interview. "It is near the lower end of a gorge cut through 100 miles of mountains—a gorge deeper and steeper than our Columbia River Canyon. The dam, to be the world's largest, will tower 750 feet, will create a 250-mile reservoir, will irrigate from 10,000,000 to 12,000,000 acres, will turn 96 generators, and will cost one billion dollars. The Bureau of Reclamation is now working on plans, designs, and specifications for the Yangtze Dam, under a contract with the Chinese Government in cooperation with the Department of State. The work is being paid for by the Chinese Government, but the Bureau of Reclamation has no responsibility whatsoever for the actual building of the dam and does not know what the Chinese Government is doing toward the beginning of actual construction. When

(*Continued on page 251*)

TALKING TURKEY

There's Many a Slip 'Twixt the Poult and the Platter, but New Mexico's Birds Give Real Cause for Thanksgiving.

by J. P. WOODWARD
Region V, Amarillo, Tex.

Since the days when our Pilgrim forefathers, giving thanks for the year's blessings, crowned their festive boards with plump, savory, wild turkeys, those majestic American birds have been definitely associated with the Thanksgiving season. The Turkey Day custom has spread from its early New England setting to every spot in the United States where people are thankful for the good things the year has brought.

New Mexico, "Land of Enchantment," gives its inhabitants much to be thankful for and, as they hold festival in the traditional manner, the chances are about two to one that the turkey which graces their Thanksgiving dinner table was raised in Colfax County. Here, 65 percent of the entire New Mexico turkey crop was raised this year.

The Colfax County turkey growing industry centers around the town of Maxwell, N. Mex., population 492, 30 miles south of the Colorado line, nestled comfortably in the protective foothills of the majestic Sangre De Cristo range of the Rocky Mountains. Ruts made by heavy freighters and the cumbersome covered wagons which traveled the old Santa Fe Trail are still discernable, and sightseers view ruins of the Clifton House, regular overnight stop for stagecoaches, occasionally patronized by "Billy The Kid" and other famous or infamous characters who lent color to the old West.

Thanksgiving to residents of the Maxwell community has an added significance. It means a market for thousands of turkeys raised in the cool, dry climate which is ideal for bringing the delicate birds to successful maturity. Most of the 35,000 turkeys of this year's crop were raised on irrigated lands of the Maxwell irrigation district, some of whose members have been wrestling with water problems since the mountain streams were first put to work for man in 1888.

Development of the turkey industry came about largely through the efforts of John S.

"THAT'S THE ONE," says Mrs. R. N. Hegenbart, as she picks out a bird to grace her Thanksgiving dinner table.

Sherritt, owner of the Maxwell Farms, and his sons, John S., Jr., who manages the enterprise, and George, who is now in the Army. The business started modestly with 4,200 birds in 1943, and has grown steadily to the present 20,000. Climatic conditions and careful handling by trained men cut losses to a minimum. And losses can be great if turkeys are not properly handled.

Mr. Turkey gives his grower some anxious moments before he arrives in golden-brown glory in the center of your Thanks-

"GOBBLE GOBBLE," the ill-fated bird voices a protest as Louis and Mrs. Hegenbart approvingly inspect the selection.

giving Day dinner table. The Maxwell Farms buy poults which arrive by plane when from 6 to 24 hours old. Nature has provided each poult with a yolk sac which keeps him alive for the first 48 hours. After that it is a continuous battle with disease and the elements to bring him to maturity.

First is the tedious task of teaching the young poults to eat and drink, for each must individually be taught the art of self nourishment. Each of the tiny bills are dipped into water, and the poult is watched to see if it swallows. The process is repeated as an extra precaution, and thus the poult learns to drink. Hard-boiled eggs sprinkled in starting mash attract the poult's eye with their bright colors, and soon the little fellow is merrily peeking away, proud of his new achievement.

Few losses occur in the first 2 days, but from the third day on casualties increase. From 3 days to 2 weeks of age, the poults are susceptible to several diseases, omphalitis, a navel infection, being the most prevalent. After 4 weeks, a series of respiratory maladies, with unpronounceable names, endanger the flock, and the most careful handling is necessary. Sanitation is a "must," and a veterinarian, skilled in the diseases of turkeys, is constantly on hand.

The turkeys are grazed on alfalfa pasturage, 3 acres furnishing grazing for a week. The flock is then moved to a new ground, and the grazing is discontinued at the former location for from 2 to 4 years to prevent the possibility of blackhead infection, a disease acquired by turkeys grazing on ground infected by droppings from a previous flock.

During the grazing period, the turkeys are constantly in danger of being frightened by storms or unusual occurrences into a sudden stampede. When that happens hundreds may pile up in fence corners or roosting pens and smother to death. In stormy weather, they are "policed" continuously by men with sticks who patrol areas where they may stampede and suffocate.

In the latter stages of their development, the alfalfa diet is supplemented with grain to add those extra pounds which mean money to the owner and additional succulent morsels for the consumer. When the turkeys finally reach the market they are a prime delicacy, for those raised on the Maxwell Farms are the envied Broad-breasted Bronze variety, which produce 40 percent more meat than the average breed of a few years back.

"HURRY AND GET IT OVER WITH," says Louis, as R. N. Hegenbart prepares to administer the coup de grace.

"IT WON'T BE LONG NOW," says Mrs. Hegenbart as she draws the golden-brown delicacy from her modern oven.

Thanksgiving 1946 -

A Message From the Commissioner
o the Reclamation Farmers of the West

On this, the second Thanksgiving since VJ-Day, I should like to sit down with you at your table and offer thanks for the good things the year has brought. As I cannot do this in person, I am taking the opportunity to visit with you in this, the first Thanksgiving issue of the Reclamation Era since 1941.

I want to say that I realize, as well as you, that the blessings of peace are tinged by the shadows of war and reconversion.

But there are still many things for which we can all be thankful. Among the unalloyed benefits of peace are the bountiful crops which have been harvested in reclamation areas, and the increasingly good uses which you have applied to irrigating your lands. These have paid off in many ways—not the least of which was your ability to ride out the water shortages in the Southwest this late summer.

We can all be thankful that the veteran settlement programs are starting to get under way and that some men will soon be able to satisfy the age-old urge to till their own land and make their living from the fruits of the earth. But these settlement programs have not yet even begun to meet the demands.

Construction has been started on many new reclamation projects and postwar work has been resumed on many others which will add to the value of irrigated lands and provide water for other lands never before cultivated.

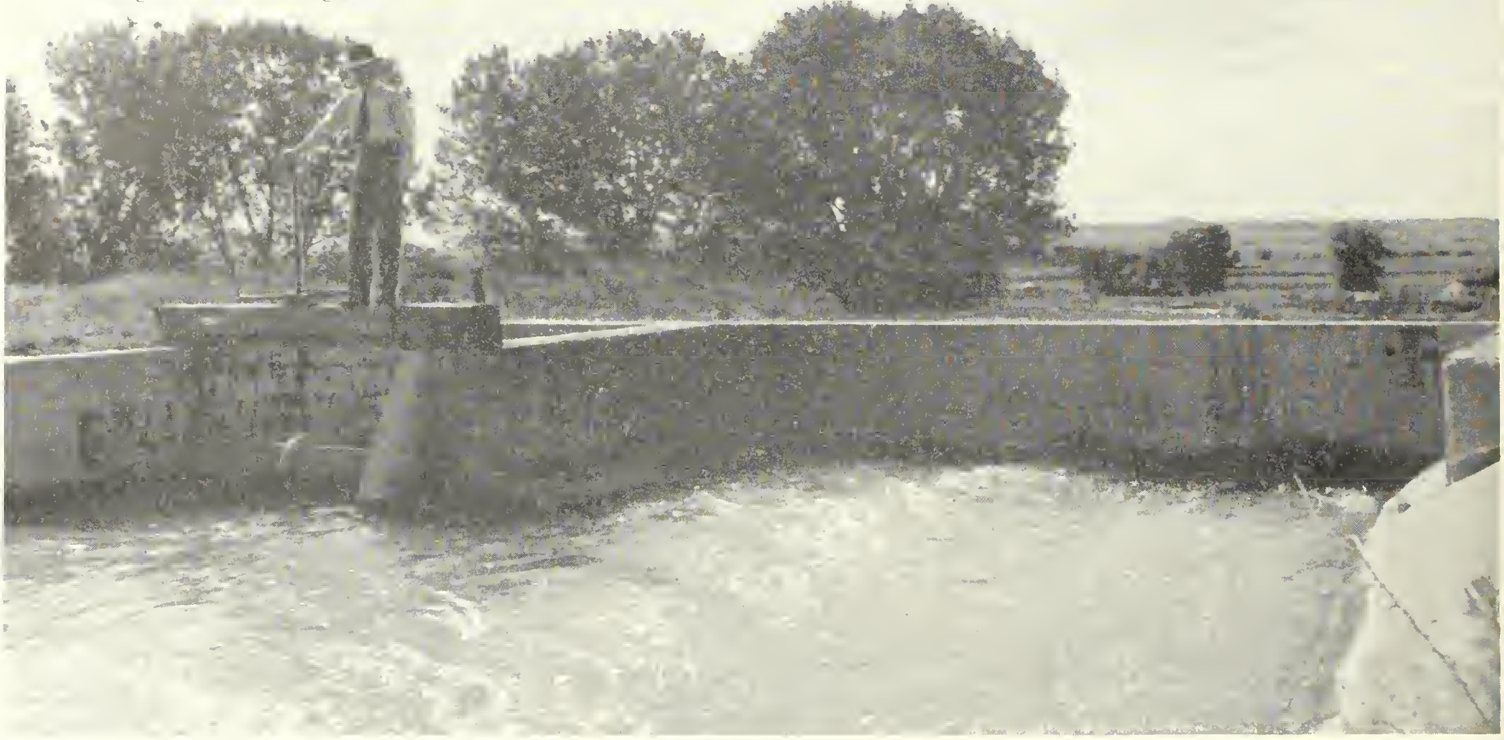
As with the early settlers on their first Thanksgiving celebration, this is a time for counting the favors of the year past and preparing for the difficult tasks ahead. But on this one day of the year, we can relax, eat well, count our blessings, and look forward to what we may do to secure our progress in the next 12 months.

A hearty good Thanksgiving wish to you all.

Michael W. Straus
Commissioner of Reclamation.

Pumping for Prosperity

By BOB BRANAM
Region VI, Billings, Mont.



Cooperation from all, to solve the problems of only a few, spreads benefits throughout the entire Huntley project

A new era in any reclamation development is reached when farmers assume, for better or worse, the operation and maintenance of lands and waters of the project.

If there then develops a spirit of independence, and pride in the possession of facilities created and constructed so that fruitful acres can produce crops in ever-increasing abundance, the future of that project is assured.

There are many ways that this pride can be evidenced. Farmers of the 39-year-old Huntley Reclamation project, located in the Yellowstone Valley east of Billings, Mont., recently purchased and installed two modern hydraulic pumps to supply irrigation water to approximately 5,000 of the project's 32,500 acres.

The pumps replaced equipment that had been in operation for many years. To defray, in part, the $54,000 required to purchase new pumps, the Huntley project irrigation district expended reserves accumulated during its years of operation. Increasing operation and maintenance charges from last year's $1.80 an acre to $2 will enable project farmers to pay the balance.

All water users of the Huntley project are assisting in the payment of $54,000 for new equipment, which serves but a portion of the total project acreage. While a small percentage of the project farmers will be directly benefited, all are contributing their proportionate share of the expense involved.

That water flowing through a canal can be utilized to lift part of that flow to a higher level, so that additional acres can be served, is by no means an innovation, but the efficiency of that operation comes as a distinct surprise to many observers.

Modern in design and operation, the new pumps are capable of lifting 100 second-feet of water from the main irrigation artery to a high-line canal serving 4,915 acres. This canal, at its point of beginning, lies 42 feet above the parent stream.

The irrigation facilities of the Huntley project are relatively simple when compared to the more recent developments in reclamation history. Water is diverted from the Yellowstone River, 2 miles above the little town of Huntley. The diversion works originally consisted of a reinforced concrete structure to direct water from the river without the aid of a dam. Since the original construction, a low concrete diversion weir, 10½ feet high and 250 feet long, was built to raise the level of the water at the intake. The dam extends from the south bank of the river to an island in midstream.

Flowing for 14 miles through the main canal, providing, on its way, an ample supply to 15,150 acres of project land, the diverted waters of the Yellowstone reach the pumping plant. Here the 300-cubic-feet-a-second flow falls 35 feet to the twin hydraulic pumps. In that fall, sufficient energy is captured in the vertical turbines to lift 100 cubic feet of water each second up through a conduit to the high-line canal.

Two hundred second-feet of water, having accomplished the task of lifting a third of the original flow to the high-line canal, continues its original mission, the irrigation of another 9,150 acres of project land.

Waters delivered by the turbines to the high-line canal serve areas of the project

A WATER ELEVATOR—This unusual-looking building is a pumping station serving the main Huntley project canal. The larger tubes at the bottom are the entrance points for main canal water. Once in the pumping station, the water turns the turbines which develop the power to force the water through the upper tubes into the Highline Canal, 12 feet higher than the main canal.

known as the Highline Bench and parts of the Eastern and Fly Creek Divisions. Even then its work is not completed though it does have an opportunity to rest. At the end of the 8-mile-long high-line canal, the remaining load drops 38 feet to an equalizing reservoir. In 1936 Civilian Conservation Corps enrollees constructed the Anita Dam and reservoir so that farmers along the lower reaches of the high-line canal could be constantly assured of a sufficient supply of water when the need arose.

Equipment used prior to the new pump installation included a hydraulic unit installed in 1906 and a 200-horsepower Diesel plant placed in operation in 1918. These units were purchased by the Federal Government as an integral part of the project irrigation works.

The hydraulic unit provided adequate service for many years, delivering water for less than 20 cents an acre-foot. The Diesel plant, originally intended as an auxiliary, was expensive to operate from the onset and by the last year of its operation, 1945, the cost per acre-foot for water delivered had risen to $2.40.

Because of this, members of the district decided to replace their entire pumping system with modern equipment patterned after the reliable and economical-to-operate hydraulic system.

Farmers organized the Huntley project irrigation district in 1921 and the project works were transferred to it in 1928 for operation and maintenance. The district owed a total contracted construction debt to the United States slightly in excess of $1,800,000. On June 30, 1946, more than $715,000 had been collected and paid the United States.

When the district assumed direction of operation and maintenance of the project, 21,800 acres of the irrigable area was cropped or under cultivation. The total gross crop value that year was $698,430 or an average crop value per acre of $32.04. Last year's return from 24,694 acres had a total gross value of $1,228,151, an average crop value per acre of $49.75.

Alfalfa, small grains, sugar beets and seed are the principal crops grown on the Huntley project. During recent years peas have proven to be a profitable crop on the rich lands of the project.

The realization that irrigation has enabled a community to secure something all mankind desires, a fair share of economic stability, resolves itself.

The installation of a modern pumping unit as a part of their irrigation works is but one brief chapter in the history of the Huntley project irrigation district. There will be many others.

It Works Both Ways

(Continued from p. 245)

plans and specifications have been completed, it is anticipated that China will advertise for bids among the world's largest contractors. Morrison-Knudsen, Inc., Boise, Idaho, already have the contract for exploration drilling, tunnels, and shafts."

A reclamation city will be built at the dam site, and Jones plans for his wife, Mina, and their children, Leanne, 10, and Larry, 7, to join him when conditions permit.

The Yangtze River will be a long hop from Crystal, Kans., where Jones was born on March 26, 1912. Despite the geological sounding name of his birthplace, Jones attributes his interest in geology to the fact that he was raised in the mining State of Colorado.

He took his first geology course as a freshman in the Peyton, Colo., high school, and was graduated from Colorado State College in 1933 with an A. B. degree in geology and many hours' study in engineering. He worked in the Alma and Fairplay mining camps of Colorado for more than a year and for an oil company in Wyoming for 5 years before joining the Bureau of Reclamation. Starting as an inspector at the Columbia Basin project in 1940, he joined the geological investigation staff 9 months later, and took charge of the organization in 1942, succeeding R. L. Nichols.

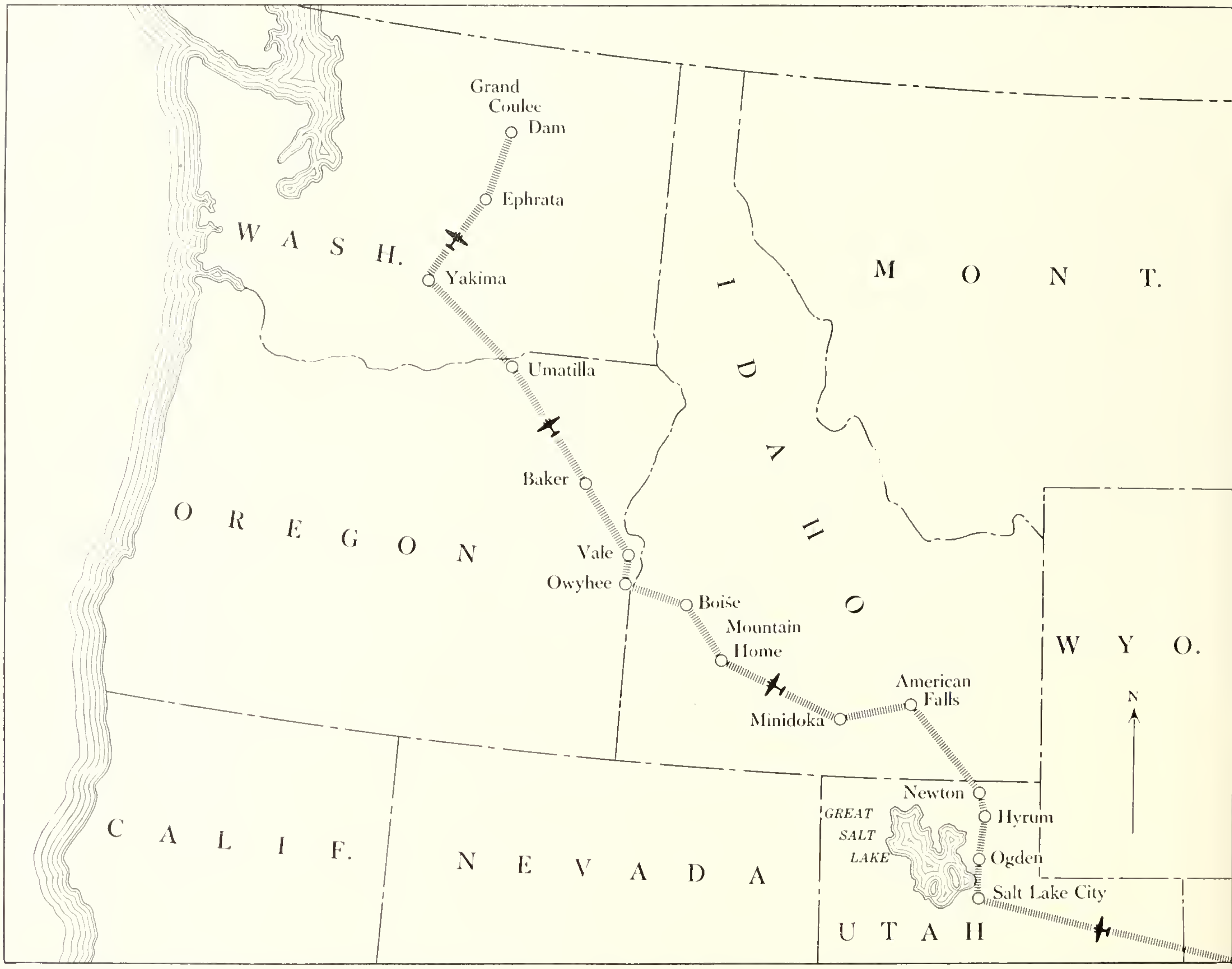
Under Jones, the department has made detailed geological studies of the foundation sites for the four earth-and-rock fill dams that will form part of the Columbia Basin project irrigation system, the north and south dams in the Grand Coulee, the Long Lake Dam, and the Potholes Dam, and of formations along routes of the feeder canal, main canal, Bacon tunnel, and Bacon and Soap Lake siphons.

The geology staff also has investigated landslides along the Columbia Valley, particularly the shore line of the Franklin D. Roosevelt Lake. It "exercises technical control" over diamond core drilling, and interprets the cores for use of planning, designing, and constructing engineers. It indicates formations on topographical maps, and makes up geological cross-sections of areas where engineers are to build structures. Models are used extensively.

The staff currently consists of 10 employees, including geologists, geological aides, a draftsman, and clerical help. Jones' office is on the ninth floor in the west powerhouse.

How Reclamation Looks From the Air

by J. A. KRUG, *Secretary of the Interior*



THE ROUTE: Flying a mile above the earth, Secretary Krug surveyed these projects between 1 p. m. (mst) June 10 and 1:30 a. m. (mst) June 11, 1946, during his first trip to the Northwest since his appointment

From the copilot's seat of a C–47, I saw 13 major Reclamation projects in less than 24 hours.

Pioneers took three weeks to travel from Pocatello to Boise, Idaho, over the old Oregon Trail. The subsequent development of the Northwestern States was built with the same sweat, muscle, and resourcefulness that blazed that trail in American history. I flew over that particular trail in less than 2 hours last June. I saw the same wagon ruts, cut deep here and there by a century of erosion. From the plane, they were almost obscured by what appeared to be other trails—trails equally as important in the development of the West. On closer view they proved to be the ditches, canals, and laterals of vast irrigation projects. Without them the West could not have prospered.

This was part of a 2-week tour I took through the Pacific Northwest early in June. I wanted to see what some of the West's problems looked like; I wanted to get at first hand the views of as many people as possible on the major problems confronting the Department of the Interior; and especially I wanted to diagnose some of the West's growing pains. By flying, I was able to cover longer distances more quickly, and confer with many more people. While in flight I was able to get a top view of many of our National parks, Indian reservations, public land areas, reservoirs, and Reclamation projects.

My aerial inspection began at Laramie and we continued to Butte and Denver. We started from Salt Lake for our trip over the 13 concentrated Reclamation projects.

After climbing into the copilot's seat, I unfolded a special aeronautical chart of Reclamation projects prepared for me by the Bureau of Reclamation. With this was also a thumbnail description of each project indicating principal features I might like to see. Furthermore, Commissioner of Reclamation Michael W. Straus, along with regional Reclamation officials, gave me a running commentary on what we were seeing below.

Major Stanwood, our pilot, leveled off at 10,000 feet over the Bonneville basin and headed for Pocatello, Idaho, approximately 150 air-line miles away. On the way we saw

the Weber River, Ogden River, Hyrum, and Newton projects.

About 10 miles north of Salt Lake City, they called attention to the irrigated lands of the Weber River project over on our right. Fifteen or 20 miles beyond the project I could see the reflection of water in Echo Reservoir, a lake with a capacity of about 74,000 acre-feet. As I was informed, this reservoir provides supplemental water for 91,000 acres of land, some in the Weber Valley and considerably more adjoining the city of Ogden on the south and west.

As a matter of fact I could not tell where the lands of this project ended and those of the Ogden River project began. From the base of the mountains to the edge of Great Salt Lake, and from near Kaysville to north of Brigham, Utah, the area looks rich and green with a network of water-filled canals, and smaller laterals. I could see many prosperous-looking farms below and could well understand how this entire valley had achieved a reputation for rich lands and valuable crops.

*GETTING DOWN TO EARTH at Boise, Idaho, everyone gets first-hand information**

The irrigated lands of the Ogden River project extend from the north and east side of the city of Ogden to above Brigham. As we passed over the city I caught a glimpse of Pine View Reservoir, located far up Ogden Canyon. It was called to my attention that Pine View Reservoir is actually a reservoir on top of a reservoir. The city of Ogden obtains municipal water from artesian wells now completely submerged by Pine View Reservoir.

As we flew northward along the Ogden-Brigham Canal (25 miles long), I got a lot of satisfaction out of seeing what this project produces. Orchards of peaches, apples, cherries, and apricots, and extensive truck gardens were pointed out to me. Poultry and dairy farms were obvious for their distinct buildings. Commissioner Straus pointed out that the canning industry is a very important factor in marketing there. I noted processing plants for this purpose on the outskirts of Ogden, Perry, and Brigham.

Over Brigham I had Major Stanwood alter our heading slightly to take us over two smaller projects—Hyrum and Newton. Irrigated lands of the Hyrum project extended from above the town of Hyrum over to the edge of Wellsville, and to a point several miles northeast of Mendon. From the air, the size of farms appeared quite small—perhaps under 20 acres on the average. The Newton project, less than 5 minutes flight farther on, appeared about completed. Commissioner Straus told me that it now provides water for over 2,200 acres of land.

It would take a poor navigator to miss Pocatello, as the city lies near the eastern shores of large American Falls Reservoir, one of a series of reservoirs of the large Minidoka project on the Snake River. Even at the altitude we were flying, we could not see the entire project at one time as irrigated lands lie 30 to 100 miles downstream, actually beyond another large lake—Lake Walcott.

It was not until we were over American Falls Dam, that we could see the waters of Lake Walcott, and stretching beyond the lake, more irrigated lands of the Minidoka project.

As we passed over the town of Burley, Idaho, Regional Director Bob Newell called my attention to Milner Dam, 12 miles below Burley, which diverts water for the Gooding division of the Minidoka project. He told me that this division consists primarily of a canal 70 miles long extending from Milner Dam to Big Wood River. This canal, extending like a ribbon of steel into the horizon, delivers not only the natural flow of the Snake River, but also storage released from American Falls Reservoir.

The little river village of Glens Ferry, about 50 miles below Twin Falls, marks the beginning of the proposed Mountain Home project. This project, when authorized, will offer an opportunity to establish nearly 3,000 farms. Under existing laws, and regulations of the Department of the Interior, veterans of World War II have 90 days preference in filing applications for homesteading on public lands opened for irrigation settlement. Mike Straus indicated that 60 percent of the area is still in public domain.

Viewed from the air, the proposed area looks like a desert, which it is. Proposed project lands for the most part comprise a sage brush covered plateau or table land between the Snake River over on our left, and the foothills on our right. Beyond those foothills construction was proceeding on Anderson Ranch Dam. I had expected that Snake River water might be involved. But Bob Newell pointed his finger down at the canyon of the Snake and said that the project lands averaged 800 feet above the waters of the Snake—too high to pump economically, at least in the present stage of technical development.

About 400,000 acres of this plateau are believed suitable for irrigation farming. After having seen all the tremendous irrigation developments farther up the Snake and in Utah, I had no difficulty visualizing the large number of family-sized homes that might be created for veterans on this sage brush plateau.

A few minutes beyond the Mountain Home area, I got a kick out of seeing in the distance the same thing that encouraged the weary pioneers a century ago: La Boise—the woods—the welcome trees that gave the great city of Boise its name. In a few minutes more we landed, less than 3 hours after leaving Salt Lake City. The flight through Utah and down the Snake Valley had certainly demonstrated what irrigation has done and is doing in developing the West.

The next day we flew over the Boise, Owyee, Vale, Baker, Umatilla, and Yakima projects.

We landed at Ephrata near the center of a vast area to be irrigated by Grand Coulee Dam and motored to Reclamation's mightiest of all man-made dams. Standing on the great dam with Frank A. Banks, supervising engineer of the Grand Coulee project, I saw more than power, more than improved navigation, more than floods controlled, more than recreation and wildlife facilities. As I looked out over Franklin D. Roosevelt Lake, I could visualize how irrigation is developing America's river resources. I caught the enthusiasm of every reclamationist who realizes that the future of the West depends upon just such projects as those I had seen during my brief, but impressive, mile-high view of Reclamation.

*From left to right: R. J. Newell, Regional Director, Region 1; Michael W. Straus, Commissioner of Reclamation; J. A. Krug, Secretary of the Interior; and Floyd Jeffery, farmer.

Jim O'Sullivan—

THE GRAND OLD MAN OF GRAND COULEE DAM

By E. R. Nicolai, Region I

Somewhere, perhaps in an old-style steamer trunk, there may be found a piece of yellow wrapping paper which is as important in the chronology of the famed Grand Coulee Dam as the title to the site now occupied by man's mightiest river barrier.

On that piece of wrapping paper, if it still exists, will be found a letter to a New York engineer from Jim O'Sullivan, the man who gave up a law career and a prosperous Michigan contracting business to devote his life to a crusade that culminated in the building of the Grand Coulee Dam, hub of the million-acre Columbia Basin irrigation project in eastern Washington.

The story regarding the "wrapping paper" letter dates back to 1920, when Jim O'Sullivan made one of his many privately financed trips to the dam site. Returning to the nearest town, Coulee City, 30 miles away, he resolved to get a noted engineer's opinion regarding the feasibility of blocking off the Columbia River to generate power and to provide water for the great expanse of dry land in the Big Bend of the Columbia.

Unable to find suitable stationery at the hotel in Coulee City, Jim O'Sullivan borrowed a piece of wrapping paper, and penned a letter to "Hugh Cooper, Builder of Keokuk Dam on the Mississippi, New York City." Impressed by the writer's enthusiasm and sincerity, Mr. Cooper came West and examined the site with Mr. O'Sullivan. Together, they discussed the idea of putting the Columbia to work, and when Mr. Cooper returned to the East he was a confirmed disciple, one of the many thousands to be converted by the pioneering spirit of Jim O'Sullivan.

There were others, too, who traveled through the dust and sagebrush of eastern Washington with Jim O'Sullivan to view the surging Columbia. There was A. P. Davis, Commissioner of the Bureau of Reclamation, who also viewed the proposed site in 1920; Willis T. Batcheller of Seattle, hydraulic and electrical engineer; and many Congressmen and State officials. Disappointed homesteaders, whose crops were burned out by the hot eastern Washington sun, listened to the lawyer who had turned conservationist.

But there were many skeptics. The same year that Mr. Cooper and Commissioner Davis journeyed to the site, the State Survey Commission rejected the proposal for a dam at Grand Coulee. That was a hard blow to Jim O'Sullivan, but his Irish pluck carried him through.

"It was a battle back there in 1920," he recalls. "Powerful interests were opposing Grand Coulee Dam, but the sagebrushers saved the proposal from the death sentence imposed by the State Survey Commission."

Although his contracting business in Michigan demanded his presence there, Jim O'Sullivan remained in the basin to fight for the dam.

"I devoted 3 months to a study of the Grand Coulee Dam, and carried on extensive publicity in the newspapers," he said. "Commissioner Davis was a great help. He recommended core drilling at the site in 1921; he appointed a board of engineers, headed by D. C. Henny, which recommended further investigation of the dam; and it was upon Commissioner Davis' recommendation that the State of Washington appointed Mr. Batcheller to study the problem.

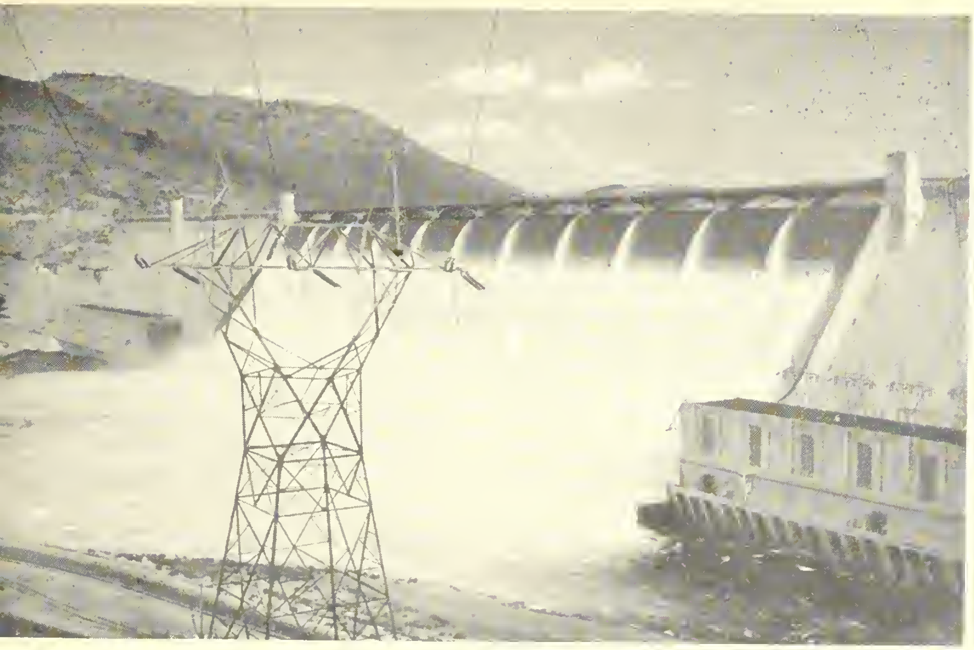
"Mr. Batcheller worked out a plan similar to that now being followed by the Bureau of Reclamation in developing the Columbia Basin project. He proposed a dam on the Columbia, near the Grand Coulee, and the pumping of water into a higher reservoir to be established in the Grand Coulee."

While various studies were continuing in the basin, Mr. O'Sullivan returned to Michigan. He had received no remuneration for his work in the basin, but he was elated at the progress being made. His joy, however, was tempered by the fact that his firm had lost a valuable contract because of his absence.

Today, as in the 1920's, people are somewhat puzzled by the fact that a native of Michigan, schooled as an attorney, spent his own money and more than a quarter of a century of his life, working in the interests of the Columbia Basin project. When questioned on this point, Mr. O'Sullivan answers with characteristic directness: "Because I have faith in the future of my country."

Born in Port Huron in 1876, Mr. O'Sullivan was granted his law degree at the University of Michigan in 1902, and entered private practice. He later joined his father's contracting firm at Port Huron, and in 1905 he made his first trip to the West to help construct an office building in Seattle. He later became a member of the normal school faculty at Bellingham, Wash., and in 1910 he returned to his law practice, establishing an office at Ephrata, Wash., now headquarters for the irrigation-construction program of the Bureau of Reclamation.

In 1910, many dry-land farmers were experimenting with irrigation of basin lands by pumping from Moses Lake, south of Ephrata. Jim O'Sullivan's pioneering spirit



Man's Mightiest

vas whetted, and he entered whole-heartedly nto the development of the Moses Lake area. By 1915, however, he was forced to return o Michigan. His father had died, leaving he contracting firm to his son.

Although Jim O'Sullivan remained in Michigan during the next 4 years, his love or the West did not change. In 1918, he eceived word that Rufus Woods' *Wenatchee World* had published as front-page news he proposal of William M. Clapp, Ephrata ttorney, that a gigantic dam be contructed on the Columbia, near the Grand Coulee, and that some of the water be iverted into the coulee for irrigating ferle lands in the basin.

This plan captured Jim O'Sullivan's imgination, and the next year found im in the basin as one of the leaders of a mall group of far-sighted men trying to ain support for the proposal. *The Wenatchee World* gave liberally of its space to he ever-busy pen of Jim O'Sullivan, the nan who subsequently was to write many housands of personal letters to friends and ceptics before the dam was built.

Typical of Mr. O'Sullivan's articles was he one that appeared in *The Wenatchee World* on May 14, 1919:

> It is unnecessary to speak at length on the stern ecessity and extreme advisability or of the favorble state of public opinion that exists for the clamation of the Columbia Basin lands. We ust devote our attention to the great problem of ringing the water to the lands. The public lands the United States having gone, there can be no reat extension of agriculture until the vast desert reclaimed.

However, the public remained only lukearm toward the dream of Rufus Woods. Villiam Clapp, W. Gale Matthews, Jim O'Sullivan, and others who were trying to ain adherents for the Grand Coulee Dam.

"The next 10 years were rather slow," Mr. O'Sullivan commented. "By February 1929 the Grand Coulee proposal was literally dead and buried. I returned to Ephrata, and took up the battle for the Coulee Dam, at the same time that Lt. Col. John S. Butler, United States Corps of Engineers, began his studies of the development of the Upper Columbia.

"In 1929, a little group from towns in the basin formed the Columbia River Development League to work for the dam. I was made executive secretary."

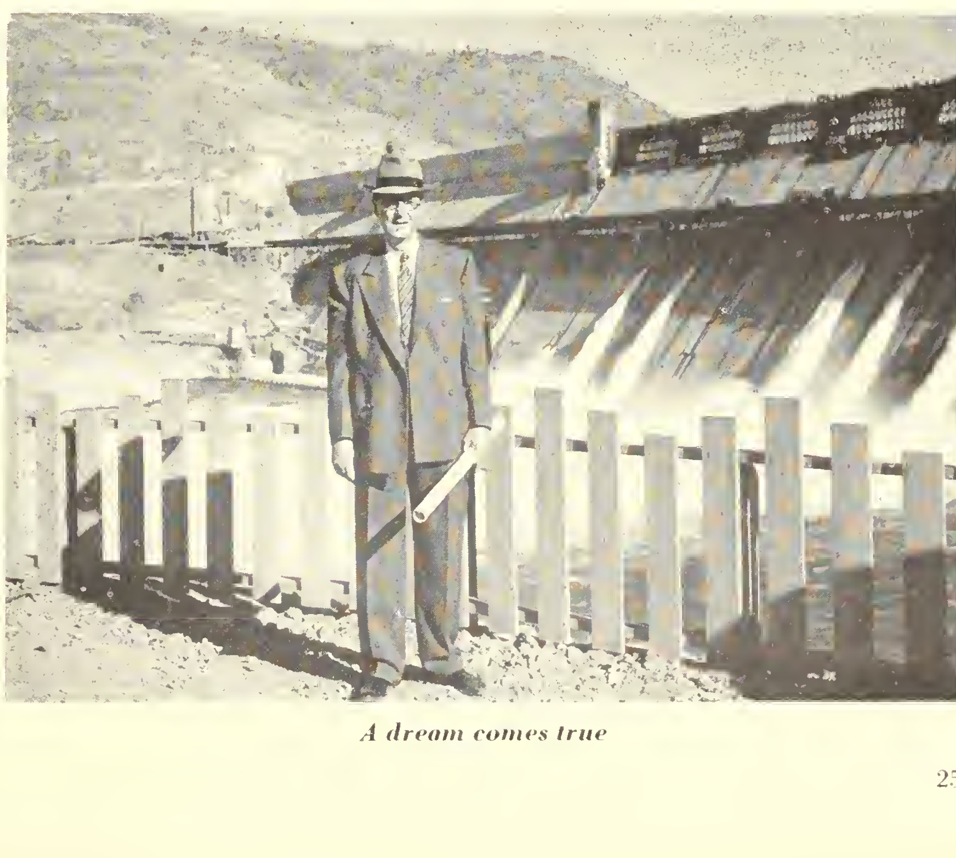
He traveled throughout the Pacific Northwest and delivered hundreds of lectures, discussing his problem with newspaper editors and representatives of commercial groups. He spoke on the radio, wrote articles, conducted research. And he organized campaigns for contributions. Some donations were nickels and dimes.

"But," he relates, "in the next 4½ years we raised $13,000. We carried on extensive studies of the power market, the feasibility of pumping, and the various multiple-purpose developments of the Bureau of Reclamation. In 1932, I went to Washington, D. C., to seek support, but the effort was futile except for a splendid hearing on House bill 7446, a bill to authorize the construction of the Columbia Basin project, which became the project bible."

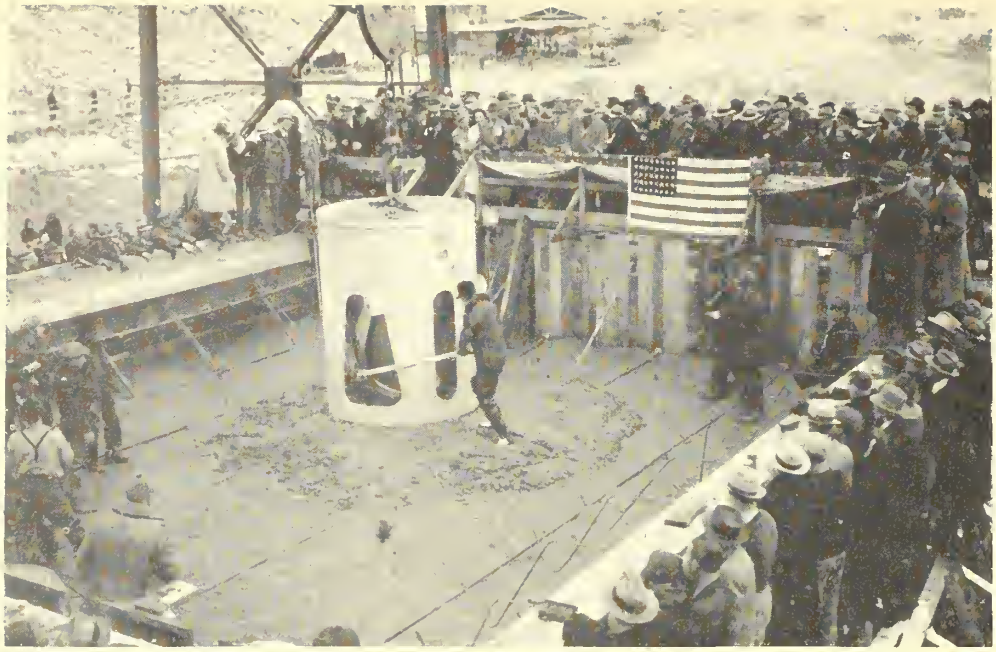
Another forward step was taken in the spring of 1933, when the State created the Columbia Basin Commission "to secure the early construction of the Columbia Basin project." Jim O'Sullivan was named secretary. Later that year, the State provided funds for preliminary engineering work, and on July 27, 1933, the Federal Emergency Administration of Public Works approved $63,000,000 to begin construction of the dam. In December 1933 the Bureau of Reclamation let the first contract.

Throughout the following years, as the mighty dam began to take form, Jim O'Sullivan continued to fight for appropriations to complete the structure. His law practice remained untouched. The project was his only interest. He helped override opposition to a high dam. He led the struggle to organize scattered land owners into irrigation districts. Following the formation of the three districts, he was recruited by their boards to gain congressional support for the Columbia Basin Project Act of 1943, the statute under which the irrigation development now operates.

In January 1945 the Columbia Basin



A dream comes true



The beginning, pouring of first concrete—December 6, 1935

Commission directed Mr. O'Sullivan to secure approval of the land owners in the project on the repayment contract, under which the land to be irrigated would repay less than one-fourth the cost of completing the project, the sale of power generated at the Grand Coulee Dam to pay the remainder. Like other campaigns in which he had participated, he made it a night-and-day job, but the long fight of past years had sapped his strength and he suffered a heart attack just as the campaign opened. Land owners did not forget him, however. When the ballots were tabulated, the overwhelming majority of 97 percent of the voting land owners were found to favor the contracts.

Despite his failing health and the advice of his physician, Jim O'Sullivan volunteered a few months ago to assist in the Columbia Basin Commission's campaign to speed the signing of recordable contracts, under which land owners agree to abide by terms of the Columbia Basin Project Act, including the highly important anti-speculation clause. Mr. O'Sullivan addressed land owners' meetings, gave radio talks, patiently explained terms of the contracts to hundreds of prospective settlers, and worked late into the night writing letters to many of the 6,000 land owners who recalled Mr. O'Sullivan from the early days, and wanted his counsel regarding the contracts.

While in Seattle for the land owners' meetings last winter, Mr. O'Sullivan was interviewed by the press.

"Are you not the father of the Columbia Basin Project?" he was asked by a reporter.

"No," Jim O'Sullivan replied. "William M. Clapp of Ephrata first proposed the idea for a dam at Grand Coulee. I spent all my time during the past many years getting a dam of practical size built at Grand Coulee, and in furtherance of basin reclamation."

He explained, too, that many other people were responsible for the dam, and that it would not have been possible without their assistance and the backing of railroads, civic groups, and other organizations.

Today, the names "Jim O'Sullivan" and "Grand Coulee Dam" are synonymous in the West, where a grateful population has fondly given him a title that will exist as long as the monument he helped create: "Jim O'Sullivan, the Grand Old Man of Grand Coulee Dam."

Corralling the Colorado

(Continued from p. 243)

10- or 15- or at most a 20-year program that can be completed with comfortable water margins around all edges.

There are no seers who can peer 100 years into the future. Therefore, none can lay out a plan today that would be considered satisfactory in the year 2046. Our long-range plans are not straitjackets. They are useful in providing general guides and limits when they reach beyond one or at most two decades. The best we can hope to do today is to lay out a line of action in connection with the development of a great river basin that will hold for 10, 15, or 20 years, and to revise our long-range plans at 10-year intervals to meet ever-changing conditions.

Suppose, for example, we successors of Lieutenant Ives in the Colorado River Basin had found ourselves bound for 100 years by his plan for the Colorado River. Remember, he said in 1857 that no one would ever visit the canyon sections of the river again. But 73 years later we were constructing the world's greatest dam at the spot on which he made his dismal and myopic forecast. If we had not reserved and exercised the right to revise Lieutenant Ives' long-range plan for the "profitless locality" on the Colorado River, we would still have 11 years to sit out to complete a century of inactivity.

Instead, the pioneers introduced and expanded irrigation. This development and improved techniques in transmitting electric energy made Boulder and other great dams in the river necessary and practical.

Every State and every locality of the Coloradio River Basin will reap rich rewards and the entire Nation will benefit from a sound second stage of development. Los Angeles and southern California generally need the power that the second stage will make available in the lower river. Southern Nevada and Arizona need part of the power, as well. The Imperial, Yuma, Coachella, and Palo Verde Valleys need the long-range protection that the great main stream regulating reservoirs will provide. This regulation will be helpful also in meeting National responsibilities assumed in connection with the administration of the Mexican Water Treaty. Developed areas in Arizona require supplemental water to stave off sharp curtailment of growth and production. The metropolitan areas of Salt Lake City and Denver need plentiful low-cost hydroelectric power, and they, too, must have the support of supplemental water diversions from the Colorado River. New Mexico and Wyoming and the other upper basin States are critically in need of further irrigation.

The Colorado River already has been placed in harness by the process of the States of the basin and the Federal Government cooperating to eliminate the hazards of flood and drought along the lower river and to bring the positive benefits of irrigation and cheap power over wider areas. We have the plan and the skill to carry that development a long and profitable second step forward. Cooperation and the dedication of all interests to the mutual purpose are required to get it done. There is no real danger in letting the distant future contend with some of the ultimate problems, especially since we have begun to see practical solutions for them today.

The Department of the Interior and the Bureau of Reclamation stand ready to assist all interests in the Colorado River Basin to compose differences and arrive at a mutual plan for the second stage of development. The second stage of the development of the basin should start from the year 1946.

Salt River Valley and the Water Shortage

By A. B. WEST

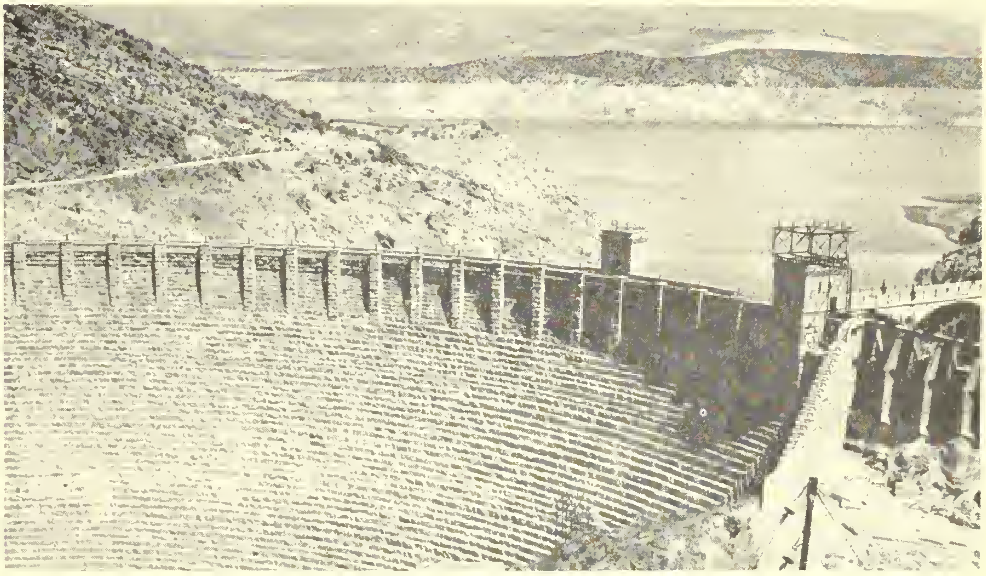
Regional Supervisor, Branch of Operation and Maintenance, Region III, Boulder City, Nev.

The Salt River Valley, like nearly all other irrigated areas in the West, experiences years of plentiful stored water and years when the water supply is limited. The current year has been one of short supply, like many such years in the past. Where good land far exceeds the water resources, as is true in all of the Western States, years of restricted water use are part of the game.

Contrary to many published accounts, however, Salt River Valley farmers have experienced no drought during 1946. The 1946 crop year will be enormously successful. Salt River farmers are applying the lessons learned in the past and have fitted the cropping program to the water available. Fall vegetables were planted in early September as usual. The sorghum seed crop is most promising with the acreage of certified seed far in excess of any previous year—so large, in fact, that the product will be sufficient to plant over a third of the Nation's sorghum acreage in 1947. To the uninitiated, the alfalfa fields looked dry in late July and August. They do every year, just as they do in the Yuma and Imperial Valleys where water is more plentiful, as the practice is to withhold water to control insect damage and undesirable weed growth. Most of the alfalfa fields now are growing the fall crop for hay or for pasturing the cattle and sheep that have moved in from range lands. Alfalfa yields for the season will be good, although not as large as would have been realized with additional winter and spring irrigation. Double cropping—the growing of winter and summer crops on the same land during the year—naturally has been curtailed somewhat, but all the land has been in crop. Plans for fall-planted grain crops are under way.

The over-all fertility conditions of the valley have not been better for years because over one-third of all the cropland is in alfalfa. This fact alone indicates that far greater modification of the cropping conditions can be accomplished if necessary.

The water impounded behind Roosevelt Dam customarily is released to Horse Mesa, Mormon Flat, and Stewart Mountain Reservoirs to maintain their water elevations for maximum power output. Pictures of Roosevelt Reservoir at low stage are not a full measure of the water available for irrigation.



"Low tide" in Salt River Valley's Roosevelt Reservoir

More careful application of water, more intensive cultural practices, and some moderate reduction in the frequency of irrigation have pulled the Salt River Valley through one of its short years. More pumping is required when gravity supplies are decreased. Lower power supplies resulting from less water behind the dams always coincide with increased demand for pumping purposes. This year power for irrigation pumping has been augmented by use of a United States Navy mobile Diesel-electric power unit of 10,000 kilowatt capacity rented for $100 a day. In addition to pumping needs, the accelerated population and commercial growth of the area have resulted in unprecedented demands for electricity.

The Salt River project itself has not been affected appreciably by the low water supply. Noticeable signs of insufficient water are evident, however, in the Roosevelt irrigation district, north of Buckeye. This district depends wholly upon pumped water. Here some cotton fields show stunted growth. Some hegari (pronounced *he-gay-ree*, a variety of grain sorghum recently imported to the Southwest for livestock feed) appears to be spotty due to insufficient water.

The Salt River Valley is, in 1946, an operating example of stabilized agriculture under irrigation. Forearmed with reliable knowledge of the volume of water that will be available, farmers tailor their plantings to that water supply. In contrast, the humid-zone farmer must plant his crop "on faith." Farmers in this favored area were never in better general condition. Debts have been paid, land improvements made, the use of fertilizers vastly increased, and land values continue to rise.

What happens in 1947 will depend to some extent upon the run-off this winter on the upper watersheds of the Salt and Verde Rivers. Irrigators can, if necessary, resort to fallowing a part of their fields, saving water for use on a reduced acreage. Although that practice would materially reduce total farm income, it by no means signifies crop failure. Farmers in the Salt River Valley recall the shortage of 1940, by comparison with which 1946 has been a banner year. Also, they remember 1941 as the year that Roosevelt Reservoir spilled. Karl Harris, irrigation engineer, United States Department of Agriculture, stationed at Phoenix, commented recently: "Except for alfalfa, the valley farmers will make as good crops as usual."

P. L. Crable, a farmer near Buckeye, says: "We have not been hurt, we have gotten enough water to get by." His view is shared by all the farmers in The Valley of the Sun. They have faith in their land and faith in their irrigation project and in the future.

There is no drought in the Salt River Valley.

Lin B. Orme, president of the Salt River Valley Water Users' Association, makes his time-tested observation: "It will rain again, it always has."

NEWS ROUND-UP

Western State Engineers Convene

At the annual convention of the Association of Western State Engineers held on September 12 at Jackson, Wyo., several resolutions of interest to reclamationists were passed and submitted to Secretary of the Interior J. A. Krug.

As a result of the first resolution, copies of the letter to Interior Secretary Krug were sent to the President, Bureau of the Budget, the Governors of the 17 Western States, the congressional delegation and the president of the National Reclamation Association. In this letter the president of the association, C. S. Clark, states that "the laws of the United States as to the conservation of water supply and the reclamation of our lands of the 17 Western States are inadequate in that they fail to provide for full cooperation between State and Federal agencies in providing for the highest beneficial use of our natural resources and the just allocation of the costs thereof."

The association then suggested that the Secretary of the Interior select and appoint a thoroughly advised and competent board to study and report suggested legislation.

In a following resolution the association urged that adequate funds be made available by the Congress for Geological Survey's cooperative program with the States in preparing water supply information, thus assuring successful development of the Nation's water resources.

Resolution No. 3 urged "in the strongest terms" that the interests and rights of the States in determining water resource development, and water utilization and control, be protected through necessary amendments to existing laws so that they provide that in the prosecution of all works designed for flood control, water conservation and use, the Federal agency or department shall, in all respects, comply with State laws relating to the ownership, control, administration, and use of the waters of these Western States, as is now required by section 8 of the National Reclamation Act. The association and its members also stated in this resolution that they would do all in their power to assist the members of Congress from the Western States in obtaining approval by the Congress of such amendments.

The appointment of Don McBride as secretary-manager of the National Reclamation Association was commended and the association pledged its full support and cooperation in his new assignment.

According to the sixth resolution, the 17 Western States are in urgent need of a comprehensive mapping program and the association urged that Congress make adequate appropriations to permit the proper Federal agencies to carry out a coordinated topographic mapping program.

In the seventh resolution the engineers recommended the compact method of settlement of interstate water programs, stating that such methods "have accomplished in a comparatively short time what lengthy litigation has failed to do in solving interstate river problems."

In the final resolution, the association urged the individual States to make a survey of the facilities available for processing and manufacturing their own raw materials, thus benefiting the area by promoting simultaneous industrial and reclamation development, and avoiding the economic loss resulting from shipping raw materials to other regions for processing and manufacturing.

Krug's Message to N. R. A.

In a letter to Judge Sawyer, president of the National Reclamation Association, Secretary Krug expressed his regrets because of his inability to attend the annual conference. The Secretary pledged full support to the Reclamation program, praising past accomplishments, and pointed out the tremendous potentialities yet to be explored through river basin development.

He said that under a full scale production program the Bureau's authorized projects would bring more than 10,000,000 additional acres under irrigation and double the present power output. He also emphasized the importance of transmission systems to carry power to the various load centers.

Veterans Settlement

The second irrigated homestead opening of 1946 was announced by Secretary of the Interior J. A. Krug October 4.

Veterans of World War II have first chance for 7,720 acres of land, divided into 83 farm units, on the Heart Mountain Division of the Bureau of Reclamation's Shoshone project in northern Wyoming.

Commissioner of Reclamation Michael W. Straus called on veterans to file their applications before 2 p. m., November 25, to compete for an opportunity to participate in a drawing of lots for farm units.

Unlike the Tule Lake, Klamath project, opening where all applicants with minimum qualifications got their names in the hat, only the top-scoring group of Heart Mountain entrymen will be initially drawn for farms. A local board, endorsed by local veterans' organizations, developed the procedures and regulations governing the opening. The same board will rate the applicants on the basis of character, capital, industry, and farm experience, set up the preferential register, and award the farm units.

If the supply of farm units outlasts the preferential register, applications received after 2 p. m., November 25, will be considered in the order received.

Copies of Public Notice No. 53, farm application blanks, project maps, and other information may be obtained in person or by mail from Bureau of Reclamation offices at Powell, Wyo., or Billings, Mont. (Post Office Box 2130), or from the office of the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

A small proportion of the Heart Mountain Division lands now being opened to entry were farmed by Japanese relocatees during the war. The lands then under cultivation yielded average crop returns of about $66 per acre.

Complete historical records of all postwar land openings will be prepared by regional directors of the Bureau of Reclamation and held available in the Washington office.

RECLAMATION READING

Bureau Publications

Available from the Bureau of Reclamation

1. *Approved Missouri River Plan Map.*—Color map of reservoir and dam sites in the basin construction program in Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

2. *Annual Report of the Commissioner, Bureau of Reclamation, to the Secretary of the Interior* (for the fiscal year ended June 30, 1945).

3. *Maps of Seven States Showing Water Resources Development of the Missouri River Basin.*—Maps of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, and Wyoming with locations (in color) of dams, reservoirs, canals, irrigable areas, and other works proposed as parts of a unified plan for the development of the water resources of the Missouri River Basin. (Also available from Regional Directors, Bureau of Reclamation, Region VI, Billings, Mont., and Region VII, Denver, Colo.

4. *Settlement Opportunities on Irrigated Farms.*—The outlook for veterans and others who would homestead on irrigated public land or purchase an irrigated farm. (Also available from your nearest Regional Director.)

5. *Boulder Dam.*—Illustrated folder on the world's highest dam. (Also available from the Regional Director, Region III, Boulder City, Nev.)

Available from the Superintendent of Documents, Washington 25, D. C.

1. *Putting the Missouri to Work.*—Illustrated summary of the unified plan for development of the Missouri River System. Fifteen cents a copy.

2. Columbia Basin Joint Investigations.—Advance studies of problems arising in connection with settlement of the million-acre Columbia Basin project in the State of Washington. Obtainable from the Superintendent of Documents. Latest releases are:

Problem 14. *Financial Aid for Settlers*—25 cents.

Problem 26. *Recreational Development of Roosevelt Lake*—75 cents.

3. *Columbia Basin Reclamation Project—East Irrigation District Appraisals.*—Report on the appraisal of lands and improvements in the East Columbia Basin Irrigation District—one of three irrigation districts of the Columbia Basin project in Washington State. Tables showing the amount of land in each class, the appraised value of land and improvements, and the total sums for each subdivision appraised. Forty-five cents a copy.

4. *Fourth Report of Operations Under the Boulder Canyon Project Adjustment Act for Year Ended May 31, 1945*, published January 4, 1946. Fourth annual financial statement of the Commissioner of Reclamation transmitted to the Secretary of the Interior concerning operation, maintenance, and construction activities of the Boulder Canyon project during the year ended May 31, 1945. Ten cents a copy.

5. *A Study of the Effect of Silt on Absorbing Light Which Promotes the Growth of Algae and Moss in Canals*, by W. E. Corfitzen, assistant engineer, under direction of C. P. Vetter, engineer, Bureau of Reclamation, Denver, Colo., October 30, 1939. 7-page mimeographed study with graphs.

6. *Control of Weeds on Irrigation Systems*, issued by the Branch of Operation and Maintenance, Bureau of Reclamation, July 1946. 71 pages (mimeographed) with illustrations. This manual discusses ditchweed problems, and brings together the most important phases of weed control developments, in attempting to obtain ideas which will enable irrigation districts to increase operation efficiency and reduce maintenance costs.

7. "Veterans—Here's Your Farm", by the Honorable John R. Murdock, of Arizona, chairman, Committee on Irrigation and Reclamation, House of Representatives. Reprint of an article appearing in the May (1946) issue of the *ERA*. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington, D. C.

8. "The Human Side", by Goodrich W. Lineweaver, Director, Branch of Operation and Maintenance, Bureau of Reclamation. Reprint of an article appearing in the May (1946) issue of the *ERA*. Obtainable by request to the Commissioner, Bureau of Reclamation, Washington, D. C.

Our Back Cover

PARKER DAM, ARIZ.-CALIF., one of the three great barriers which have converted the Colorado River from a costly destructive menace to a paying constructive enterprise is located about 150 miles downstream from Boulder. Built by the Bureau of Reclamation with funds provided by the metropolitan water district of California, it is unique in that it diverts water through the Colorado River aqueduct to the city of Los Angeles and 13 neighboring cities.

Photograph by Ray Wiggins, Region III

Notes to Contractors

Contracts Awarded During September 1946

Spec. No.	Project	Date of award	Description of work	Contractor's name and address	Contract amount
1247[1]	Shoshone, Wyo	Sept. 27	Electrical equipment, Heart Mountain and Garland.	Pacific Electrical Manufacturing Co., San Francisco, Calif.	$51,245.05
1252	Davis Dam, Ariz.-Nev	Sept. 4	3 motor-driven gate hoists	Western Machinery Corp., Portland, Oreg.	139,914.00
1369	Central Valley, Kennett, Calif.	Sept. 27	Fire extinguishing equipment	CO_2 Fire Equipment Co., Newark, N. J.	13,378.30
1376	Central Valley, Friant, Calif.	Sept. 23	Adapters and studs	Goslin-Birmingham Mfg. Co., Birmingham, Ala.	20,750.00
1395	Central Valley, Kennett, Calif.	Sept. 27	Electric elevator, Keswick power plant.	Otis Elevator Co., San Francisco, Calif.	32,386.00
1396	....do	Sept. 6	Installing 2 generators at Shasta	General Electric Co., Schenectady, N. Y.	181,080.60
1416[2]	Boulder Canyon, Nev	Sept. 4	Safety bulkheads, hoists, and doors	Gardiner Mfg. Co., Oakland, Calif.	16,300.00
1411	Shoshone, Wyo	Sept. 16	69-inch penstock, Heart Mountain	Western Pipe and Steel Co., Los Angeles, Calif.	10,435.00

[1] Schedule 2. [2] Item 2.

NOTE.—The above contracts qualify under the provisions of the Office of War Mobilization and Reconversion Directive 128 in that all such contracts are for work on projects commenced prior to Aug. 5, 1946.

Construction and Supplies for Which Invitations for Bids Will be Requested during November

Estimated date bids to be invited	Estimated bid opening date [1]	Project	Description of work or material
Nov. 1	Dec. 6[2]	Boise-Payette, Idaho	15-ton traveling crane and beam, "C" Line Canal pumping plant.
Nov. 1	Dec. 6	Boulder Canyon-All-American Canal, Calif.	Radial gate hoists, White Water Wasteway, Coachella Canal.
Nov. 1	Dec. 6	Central Valley-Delta, Calif	Structural steel for S. P. R. R. bridge and farm bridges, Westley Wasteway.
Nov. 1	Dec. 6	Colorado-Big Thompson, Colo	30-ton crane for Horsetooth Reservoir.
Nov. 1	Dec. 6	....do	72-inch outlet pipes for Horsetooth Reservoir.
Nov. 1	Dec. 6	Missouri Basin-Kortes, Wyo	Penstocks for Kortes Dam and power plant.
Nov. 15	Dec. 20	Boise-Payette, Idaho	Radial gates, Cascade Dam.
Nov. 15	Dec. 20	Colorado-Big Thompson, Colo	72-inch hollow jet valve, Horsetooth Reservoir.
Nov. 15	Dec. 20	Columbia Basin, Wash	Pipe and fittings for Grand Coulee left power plant units L7, L8 and L9.
Nov. 15	Dec. 20	Deschutes, Oreg	Willow Creek siphon, North Unit Main Canal.
Nov. 15	Dec. 20	Missouri Basin-Angostura, S. Dak	54-inch outlet pipes, Angostura Dam.
Nov. 15	Dec. 20	....do	72-inch outlet pipes, Angostura Dam.
Nov. 20	Dec. 26[3]	Altus, Okla	Reinforcement bars, Altus Canal station 610+00 to 1147+37.
Nov. 25	Dec. 30	Yakima-Roza, Wash	Pumping units for area No. 13.
Nov. 27	Jan. 2[3]	Columbia Basin, Wash	Reinforcement bars, Main Canal station 24+00 to station 130+00.
Nov. 30	Jan. 3	Central Valley-Delta, Calif	Radial gates, Delta-Mendota Canal.
Nov. 30	Jan. 3	Boise-Payette, Idaho	Hoist house, Cascade Dam.
Nov. 30	Jan. 3[3]	Columbia Basin, Wash	Elevator, block 61, Grand Coulee Dam.
Nov. 30	Jan. 3	....do	Stop logs, Grand Coulee pumping plant.

[1] Subject to change. [2] Readvertisement. [3] Previously reported for October advertisement.

Construction Limitation Raised

★ *As this issue goes to press the Bureau of the Budget announced that the Bureau of Reclamation's construction program had been increased from $85,000,000 to a tentative $110,000,000 for the 1947 fiscal year, pending a recheck of cash requirements for projects now under construction. This is a revision upward of the presidential limitation on construction of August 5, 1946, and permits work to proceed on 38 Bureau projects. The expenditure limitation applies only to construction projects.*

Where required to maintain orderly progress, new work on these projects will be advertised for bids and additional contracts will be awarded in the usual procedure of the Bureau.

The projects upon which work will proceed are:

Region I. *Boise-Anderson Ranch, Boise-Payette, Minidoka, Idaho; Columbia Basin, Yakima-Roza, Wash.; Deschutes, Owyhee, Oreg.; and Hungry Horse, Mont.*

Region II. *Central Valley, Calif., and Klamath, Oreg.-Calif.*

Region III. *All-American Canal (Coachella Branch), Calif.; Boulder Canyon, Davis Dam, Ariz.-Nev.; Gila, Ariz.; and Parker Dam power project, California-Arizona.*

Region IV. *Ogden River, Provo River and Scofield (WCU), Utah.*

Region V. *Balmorhea (WCU), Texas; Lugert-Altus, Okla.; Rio Grande, N. Mex.-Tex. and Tucumcari, N. Mex.*

Region VI. *Buffalo Rapids (Fallon Unit), Milk River (Dodson), Missoula Valley (WCU), Intake (WCU), Fort Peck Power, Sun River, Mont.; Rapid Valley, Angostura, S. Dak.; Riverton, Shoshone-Heart Mountain irrigation and power project, Boysen, Wyo.; and Missouri Basin transmission lines, North Dakota.*

Region VII. *Colorado-Big Thompson, Colo.; Kendrick, Kortes, Wyo.; and Mirage Flats (WCU), Nebr.*

Santa Says: *Solve your gift problems this easy way!*

12 Christmas Gifts in 1 . . .

This Xmas gift will be a year-round reminder of your thoughtfulness and will furnish the recipient with a monthly summary of the latest developments in reclamation activities.

The annual rates are one dollar for regular subscribers, 50 cents to members of water users' associations, and a dollar and a half for persons living outside the United States and Canada.

The COMMISSIONER, Date ____________________
Bureau of Reclamation,
U. S. Department of the Interior,
Washington 25, D. C.

Sir: Please send the Reclamation Era for ____ year(s) to:
Name ____
Address ____
____
The above is member of ______________________________
(Water users' association)
Address ____

Please send receipt to me:
Name ____
Address ____

I enclose a check (☐) or money order (☐) for $______ made out to the TREASURER OF THE UNITED STATES.

____

DON'T DELAY—MAIL IT TODAY!

PARKER DAM

Arizona—California

Bureau of Reclamation Photo

DECEMBER
1946

Christmas Number

In This Issue:

CHRISTMAS PAGEANT *at Madrid*

'he Meaning of ower Utilization

AMPA—Capital of Main Street America

ERA

Photograph by Stanley Rassmussen, Region I.

Our Front Cover

CHRISTMAS ALL THE YEAR ROUND

Reclamation provides all the benefits required to make an old-fashioned Christmas that lasts through all the year. Results of Reclamation projects are not confined to the West, where the projects are located, but are spread thruout the 48 States, thereby contributing to the welfare of the entire Nation.

Single Copies of the *ERA* Available

For the benefit of our subscribers and others who would like to purchase individual copies of particular issues of the RECLAMATION ERA, the following rates have been established:

	Cents
1 copy	15
6 to 9 copies	12
10 to 50 copies	10
50 or more copies	8

A limited number of copies of the May, June, July, and August 1946 issues are now available.

Make out check or money order to the TREASURER OF THE UNITED STATES and send request to the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Please do not send stamps. For small orders, coins will be accepted.

Reclamation ERA

Vol. 32 **December 1946** **No. 12**

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Contents

Credits

Art work by James D. Richardson, Georgie Petty, and Mary Edmondson, Bureau of Reclamation, Washington, D. C.

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The COMMISSIONER, **Date** ______________

Bureau of Reclamation,
U. S. Department of the Interior,
Washington 25, D. C.

Sir: Please send the Reclamation Era for ____ year(s) to:
Name ______________________________
Address ______________________________
____
The above is member of ______________________________
(Water users' association)
Address ______________________________
Please send gift certificate and receipt to me:
Name ______________________________
Address ______________________________
I enclose a check (☐) or money order (☐) for $______ made out to the TREASURER OF THE UNITED STATES.

____

DON'T DELAY—MAIL IT TODAY!

Christmas Pageant in Madrid

New Mexico's Reenactment of the Bethlehem Story Inspires Thousands of Visitors with the True Christmas Spirit

Photograph through the courtesy of the New Mexico State Tourist Bureau, Santa Fe, New Mexico.

Shrine in the Hills.

Elaborate Yuletide decorations such as these have earned for Madrid the title of the "Christmas City" in the Southwest. This daylight scene shows the choir boys, with the 36-foot Christus looming on the mountaintop.

A traveler approaching the town of Madrid, N. Mex., in the dusk of a December evening will observe on a distant hillside the life-sized figures of Mary and Joseph traveling from Nazareth to Jerusalem. Madrid resembles the walled city of Bethlehem with its overcrowded inns and lighted homes. On another hillside, lowly shepherds watch their flock. High on a mountain top are the heralding angels, guiding the Three Wise Men gazing at the bright new star in the east.

Along the streets of Madrid there are no noisy peddlers nor blaring swing bands. Crowds move with reverence, pausing to observe a replica of the Nativity, the stable which housed the Holy Family, or some similar, impressive reproduction. Triumphant music fills the pine-scented, clear, night air. Doors stand hospitably open and friendly holiday greetings are called from doorsteps. Good-fellowship reigns.

The town of Madrid lies off the main highway about 50 miles northeast of Albuquerque. From the first of December until New Year's day the crooked main street becomes a thoroughfare, warm with the glow of thousands of winking lights. A steady stream of automobiles winds along the canyon floor, bringing crowds of spectators whose curiosity is soon replaced with reverence born of the feeling that one is entering a shrine.

There is a story behind the Madrid Pageant. It had its origin a score of years ago among the miners of the Albuquerque & Cerrillos Coal Co., which has operated in the area since 1906. It was the custom for the miners to decorate their homes and set up Christmas trees during the holiday season. Then someone suggested forming a club to develop a Christmas theme into a community project. Because they all worked for the same company, they called their organization the Employee's Club.

The idea was accepted and the Christmas lights grew from year to year into a gigantic community celebration that draws spectators from far and near. At the last celebration, 1,400 automobiles were counted at the pageant on one night.

To finance the undertaking, a check-off system was operated through the company office whereby each worker contributed a certain sum each month, never more than 75 cents. The money is used to purchase material for the sets. The actual labor is done by miners, who devote evenings and Sundays to the job. The only outside help is provided by Pierre Menager, Santa Fe artist, who is employed to paint the scenes for many of the sets.

A few figures will show the magnitude of the undertaking. More than 40,000 light bulbs are used. The power they consume would approximate $10,000 if purchased at commercial rates. Two carloads of 2 by 4 stringers, more than 34,000 square feet of lumber, and 75 gallons of paint are the average annual requirements for the building of sets.

Shortages of material and labor during the war years forced suspension of the pageant. It will not be held this year, but plans are being made to revive it in 1947.

This will mean much to the 100,000 persons who visit the religious festival annually to see depicted the familiar scenes of the Nativity and to recapture the thrills of the magic Christmases of their childhood. For Madrid says "Merry Christmas" to the world with realistic life-sized scenes and figures, brilliantly lighted, which depict the holy setting of the birth of the Christ child.

More than for its long record of coal mining activity, Madrid is noted for its superb illuminated spectacle of the Christmas story. From dusk until midnight, during the month of December, Madrid is transferred from an ordinary coal camp to a glowing, dramatic setting for all the things that Christmas means.

A delightful toyland built on the edge of town offers special delights for the children. All the familiar Mother Goose characters are there, and a miniature train with a real Santa Claus at the throttle winds among story-book houses in an evergreen forest. There is a motto, "No child in Madrid shall be without a gift on Christmas Day," and it takes three jolly assistants of Saint Nicholas to fulfill this promise to town and visiting children on Christmas morning.

No attempt is made to commercialize this majestic pageant. Madrid has nothing to sell tourists. There is no charge for the beauty created. No trace of rivalry nor commercialism mars its perfection. Magnificient, yet exquisitely simple, it is a place where one can capture the true feeling and meaning of "Peace on earth; good will toward men."

Jack Nelson Gate Tender

After thirty-five years of gate tending, Kitty and Jack Nelson decide to continue their honeymoon at Bumping Lake.

by HU BLONK
Region I, Boise, Idaho

Photographs by Stanley Rasmussen, Region I.

"If the Pacific battle fleet ever sails up the Yakima River it will proceed up the Naches and Bumping and anchor at the port of Bumping Lake. Whereupon Jack Nelson, harbor master of the port, will fire a salute, greet the admiral and invite him in. Kitty Nelson, his gracious and capable wife, will sacrifice several spring chickens and have dinner underway in no time at all. Before they leave, the admiral will invite Jack and Kitty to go on a cruise around the world and, finding that Jack is obliged to stay on the job, will leave one of his old ships in the lake for fishing and other cruises. Jack Nelson is that way."

That's how a reporter of the Yakima (Wash.) *Republic* put it in describing John Henry (Jack) Nelson, who retired this September after 35 years of service as gate tender at Bumping Lake, the first of the six reservoirs of the 300,000 acre Yakima project in eastern Washington.

The personal charm of Jack Nelson and his wife, Kitty, has endeared isolated Bumping Lake to an endless number of sportsmen and vacationists, and has earned them lasting friends in all walks of life.

The Nelsons have been at the reservoir since August 11, 1911. Jack, a graduate of the University of Manitoba Pharmacy School, decided to desert a drugstore job in Yakima in May 1911 to get outdoors. He became a common laborer at $2 a day at the then new Bureau dam situated on Bumping River, a few miles from Mount Rainier National Park in the heart of the high Cascade Mountains, some 65 miles northwest of Yakima.

When the construction was completed, Jack applied for the appointment of permanent gate tender. "Sorry, but we have got to have a married man," Bureau officials told him. "Just give me a week," he said. Sure enough, within the allotted time he was back with his bride, the former Kitty Bryden of New York City, who had been a cook in a Yakima restaurant. "We came up here on a honeymoon," Jack now says, "and we are still on it."

For 17 years their nearest neighbor lived 23 miles away. Now there are some but 3 miles distant. In the early years they were snowed in from about the first of November until the middle of March. The period is somewhat shorter now. The average snowfall is 17 feet, although one year 39 feet of it came down.

Situated at an elevation of 3,435 feet, the temperature often has dropped at 32 below zero. The average minimum is 5 above. "It is no country for a sissy," says Jack.

"I guess I like the outdoors because my mother and father were born in the mountains of Scotland," is Jack's explanation for his long stay at Bumping. How satisfied he is with his existence is indicated by the fact that he has "slept away" only once since a year ago last November.

Nelson's job consists of releasing water for irrigating the land of the Yakima Valley, maintaining and repairing equipment, burning drift logs, and in general doing the various odd jobs required to keep the 3,800-acre-foot reservoir operating efficiently. He also takes snow measurements. He has done this longer than any other man in the State of Washington.

One of the major jobs in the winter has been keeping a 12-mile-long telephone line in operation. Some winters Nelson has skiied as much as 300 miles to repair breaks. "If our second winter had been our first, we'd have left, we had so many breaks," Nelson said. A two-way shortwave radio is also available for communication.

Life in the high Cascades is not without its hardships. Once, in 1919, when Jack had to repair the telephone line, it snowed for an entire day and night. Upon his return from the extreme end of the 12-mile-long circuit, he could break trail for only two miles the first day. "It seemed I would be delayed several days, so I got the idea of walking up the river. I phoned Kitty to reduce the amount of water flowing into the stream from the reservoir to make it easier for me. What I forgot was that the rocks and the logs across the riverbed would freeze so I would have a devil of a time walking. I was in the river 10 hours, fightin' every inch of the way. Kitty had taken her skiis and put a lantern in the river so I would know when I was near home. I

got there just as she was ready to return to the house. She was so glad to see me, she actually cried." Jack said his feet were frostbitten and so swollen he could not put on shoes for two days.

Another time, at Christmas in 1917, due to an unusually heavy rain, the water over the spillway was the highest it had ever been. Jack was in Yakima at the time. Knowing that with the continued rainfall he should be at Bumping Lake to safeguard the structure, he set out by stage for the reservoir. A bridge had washed out on the main highway, a short distance from Yakima. So he had to walk the rest of the way. It took him 10 days to make the 65-mile-long journey. Four bridges had been washed out. He had to ford each of the streams, and lay over at one point four days.

Because of inaccessibility of the reservoir, a "half-way house" was constructed soon after the Nelsons arrived. "This shack looked like the Waldorf-Astoria to us on many a stormy night," Jack said.

For recreation the Nelsons read and listen to the radio. Their favorite program is "Information Please." "Radio is a good companion," Jack says. "It puts you right on the avenue." Because of his "color" Jack has appeared on the radio himself several times. Mrs. Nelson weaves rugs, fishes, and hunts. She is one of the best fisherwomen in the country. "If Kitty Nelson can't catch them, no one can," is the saying. Deer, bear, elk, and mountain goats are frequent callers at Bumping. She trapped one bear who ate 14 of her chickens, and frequently catches mink, marten, otter, and sometimes lynx.

The Nelsons subscribed, at one time, to 17 magazines and two or three "book of the month" clubs. Mrs. Nelson says, "Jack likes the deep stuff. I like detective stories." She added, "Any person who does not like to read is out of luck up here." "The Hermit of Bumping Lake," as he once was called, has a library of several thousand books, including all of the works of Shakespeare, Dickens, and Tennyson, and the Harvard classics. The isolation of the Cascades has in no way kept him from being one of the best informed men in the Yakima area.

The mail arrives at Gooseprairie post office, 3 miles away, three times a week in the summer, and once a week in the winter. Generally, Sunday recreation consists of skiing to the post office.

As word of the Nelson hospitality spread, more and more friends and sportsmen came to Bumping, which at one time had no equal on the continent for fishing. Sockeye and Blueback salmon spawned there. The Nelsons found it financially impossible to continue to lodge and feed all of their guests, so in self-defense they erected 10 cabins and a large lodge. The cabins are occupied continuously as long as the road remains open.

Asked what they like about what many people would call a dreary existence, the Nelsons said they enjoyed being alone in the winter. In the summertime they want their friends about. The kitchen of the

"Jack-of-all-trades" giving a haircut to visitor Donald Sanford.

Kitty finds the way to her man's heart—apple pie!

At ease on skis, Kitty doesn't look her 68 years.

Working the gates for the last time on September 30, 1946.

lodge they built, and in which on some Sundays in the past Mrs. Nelson prepared 200 to 300 meals, is "A regular Grand Central Station sometimes," Jack says. Incidentally Kitty Nelson's cooking attracts as many people to Bumping as the fish. "Meals? Boy, oh boy! What meals!" publicly exclaimed one writer.

A story about the Nelsons would not be complete without reference to Jack's tall stories and other traits which endear him to his friends. He can regale a tenderfoot with yarns about weird creatures of the woods with such childlike simplicity that the hearer is fearfully impressed. Several hunters have stayed out of certain areas because of the awesome animals which are supposed to exist there. "Sitting around the fireplace in the big lodge listening to Jack tell stories is a highlight in any man's life," said one frequent Bumping Lake visitor.

No one who makes Bumping Lake a regular stopping place fails to hear about such real life characters as Uncle Tom Fife, the first white man to come to the area (1886), "Bacon Rind" Dick, a tall miner who weighed but 96 pounds, "Six-fingered Pete" (Bertoglio), a miner who had six fingers and six toes and control over all of them, and "Wildcat" Matheson, a trapper.

Jack's major extracurricular interest is big-league baseball. "My greatest ambition now is to see a World Series," he said, as excited as such a calm man could be.

The late Philip R. Ball, president of the St. Louis Browns, made one trip to Bumping and liked the Nelsons so well that, from then on, a trip to Salt Lake City was a good excuse for him to return. Jack received a season's pass to all games for as long as Ball lived. Many other prominent visitors warmed up to the Nelsons the same way. His acquaintance with a big league magnate helped many a youngster in the Yakima Valley get a chance to show his stuff before big league scouts.

Jack is very fond of poker too, and when the "city slickers" come to his house, they are in for an education. His prowess is so well known that many "swear off" the pastime while at Bumping.

While the Nelsons are retiring—you always think of them as a team—they don't intend to leave their mountain retreat. They will remain at Bumping to run their cabins most of the year. Part of the winter they will stay with their daughter in Yakima.

There's no doubt in anyone's mind that the Nelsons are a happy couple. Their recipe for a happy married life in the wilderness is, as Kitty puts it, "Never get in an argument when you are alone like we are. Give and take."

On the eve of his retirement Jack said he felt this way about spending his life in so remote an area, "We wished we were starting over again. The only thing I would do different is get all my teeth pulled so I could mail them in when I had a toothache."

The Meaning of POWER UTILIZATION

by Sidney D. Larson

Engineer, Branch of Power Utilization, Washington, D. C.

Photograph by J. E. Fluharty, Region II

Power utilization to many in the modern age means the snapping of a switch or the turning of a knob. The result is light, heat, music, or the rumble of some labor-saving device, depending on the individual's needs. To many more it means turning large and small pieces of industrial equipment to convert an abundance of raw material into useable articles—articles to satisfy the everyday wants of the people for necessities or luxuries of life. To a much smaller group, the irrigation farmer, the closing of an electric switch takes on added significance. It controls the heart of his existence—the pumps which send his means of livelihood—water to his lands—water which, to many in the Western arid States means the difference between lush, green vegetation and desert and famine.

This achievement of utilizing water for power generation as well as irrigation has been brought about by man's ability to put nature to work in achieving his desire for a better way of life. The story of reclamation started in a small way at the turn of the century. A modest program was initiated to reclaim lands from desert wastes by developing the unused water resources in the rivers and streams of the West—water which was rushing down the mountain sides through the barren lands below, where it picked up the rich soil and the soil-building minerals and carried them off to sea. The purpose of reclaiming the land was to control the water, releasing it from the storage dams at such times as it was necessary to irrigate the fields. With the development of these irrigation projects, many isolated spots began to come to life.

In the early days, the newly created projects lacked many of the modern conveniences, one of these being electric power. The lack of power facilities made it desirable to take advantage of the potential source of power in the newly controlled resource. Power plants were installed at the dam sites and the power utilized to carry on construction-camp activities. Hydroelectric power was also made available to existing power distribution systems in the vicinity. The addition of power features to irrigation projects was also beneficial from a financial standpoint, as the revenues from the sale of power were applied against the construction and operating costs of the projects.

In some instances projects are under the control of the water users and in others the projects remain under the control of the Bureau of Reclamation. As developments become larger and more complex, it is apparent that proper control of the operations can only be achieved by an organization composed of trained individuals. To accomplish this, it is necessary to retain control of the projects in a central organization, the Bureau of Reclamation. The field is beginning to broaden. In addition to irrigation, other phases of project operations are becoming more and more important. Commercial power production, water for municipal purposes, flood control, and navigation requirements are becoming of major importance, as well as recreational values and benefits to fish and wild game. Projects are being considered which would require large amounts of hydroelectric energy to pump water to rich lands above elevations that can be served by gravity flow. As time goes on, the most desirable projects are constructed, leaving the less desirable for further consideration. As a rule these less desirable projects are not feasible when considered by themselves. However, they become very desirable in the operation of large scale area developments. This leads to the basin-wide concept of development which has proved very satisfactory elsewhere.

With the advent of basin-wide development, central control of planning and operation becomes even more essential. Under this plan, it is possible to develop whole areas which heretofore could not develop as individual projects without making the cost of water excessive. In the development of a whole drainage basin, it is possible to utilize the water so that it will provide the greatest benefit from irrigation, power generation and other uses. The power development should be as efficient and large as possible since revenue from the sale of power is necessary to repay a large part of the construction costs. Power revenues not only repay the construction costs chargeable to power but also repay anywhere from 60 to 90 percent of the cost of the irrigation facilities. Without these power revenues the high cost irrigation developments would make them economically infeasible.

A well balanced regional development calls for coordinating the planning toward full utilization of all phases of water resource development. Power utilization as it is understood today is concerned with the planning and operation of the project power features to best serve the people through widespread utilization of the power resources. The public's interest can best be protected by conducting power-marketing

activities which will stimulate an increasing use of power. The most striking example of utilizing public hydroelectric power resources to the benefit of the whole country took place during the last few years.

During the war emergency, electric power generating facilities were of prime importance. Several of the Bureau of Reclamation's hydroelectric power projects were operating at reduced capacity or just beginning operations. Increased power demands were met by installing the maximum capacities possible under wartime restrictions. Examples of these were the Boulder Canyon, Central Valley, and the Columbia Basin projects. Power from Boulder Dam served the great southern California industrial area which was instrumental in producing large numbers of badly needed aircraft and incendiary bombs.

Shasta power plant on the Central Valley project supplied central and northern California through the facilities of the power company operating in the area. This procedure was necessary as a wartime expedient. The construction of additional power transmission facilities would be required to utilize additional capacity for the greatest benefit to the public. The Grand Coulee power plant contributed to a great extent to the operations of the northwest power pool, which consisted of the combined hydroelectric power resources marketed by the Bonneville Power Administration and a number of large private utility systems in that area. In fact, Grand Coulee represented the largest single unit to be placed in operation to assure the Northwest sufficient power to conduct its wartime activities. Through the transmission facilities of the Bonneville Power Administration, this power was made available to the new aluminum industry of the Northwest and contributed to the industrial development necessary to conduct ship building activities as well as activities in connection with the development and manufacture of the most modern weapon of warfare—the atom bomb. Many of the smaller power projects contributed to the power supplies necessary to produce oil, pump water for food production, and augment the power supply to areas whose wartime activities are highly diversified but nonetheless important.

With the easing of wartime restrictions these power plants are now being put to use in rapidly developing peacetime industries. Hydroelectric power will be utilized in developing the mineral resources of the West. Besides the industrial developments which use basic mineral resources as raw material, there are the new developments in plastics and other industries which will use farm produce as raw materials. The food industry will develop methods for utilizing hydroelectric power for the preparation of food for shipment to other parts of the country. Hydroelectric power may also be utilized in the canning industry by the application of short wave radiation which may prove highly essential in the food industries. All of these new industries increase the demand for agricultural products. These are the indirect benefits derived from industrial expansion made possible by low-cost power.

The direct benefits to rural areas are more tangible. Power helps in three ways: first, it produces revenue which contributes toward the repayment of the cost of irrigation facilities, thereby easing the financial burden of the water users; second, it makes possible the irrigation of lands at higher elevation through the medium of pumping water; third, it makes power available for use on the farm for domestic uses. The first benefit is not always apparent, the second is more readily visualized, but the third is apparent to the rural dweller at all times.

The development of the rural electric cooperatives has been of great value to the individual farmsteads as well as the small rural communities. Along with the development of these cooperatives, it has been possible to make power from Reclamation projects available to these groups. In many areas where power is not available it will be made available as rapidly as power generating and transmission facilities can be constructed to supply the power needs. The power thus brought to the farms through full cooperation of all concerned will ease the burden of many a hard-worked farmer.

His hours, as a rule, are long and hard. His wife also has many chores that require greater effort and more time than the leisurely life of the city requires. This need no longer be true if the farm is equipped to utilize all the modern electric conveniences. The various benefits go far beyond those which many rural dwellers dreamed of in the not too distant past. It is now possible for the farmer to have water for both domestic and farm use without physical effort. The use of power can make his water supply automatic. His farm can be equipped with milking machines, electric brooders, ensillage cutters, lights, and many other time-saving devices. Time and effort saved in performing these tasks can be used for other duties or leisure activities.

Let us look inside the farm home. The wife need only turn on the faucet to get water—hot water—made available through the application of electricity for heating water for domestic use. The husband comes in and instead of walking to the sink and interrupting the preparation of the meal, opens the door and there is a shower or tub with hot or cold water available with the flick of the faucet.

In the kitchen of the home with electric power on tap, the wife turns around to the refrigerator to get out the food which will be cooked on the electric stove. There is a deep-freeze unit and a Christmas tree with real electric lights!

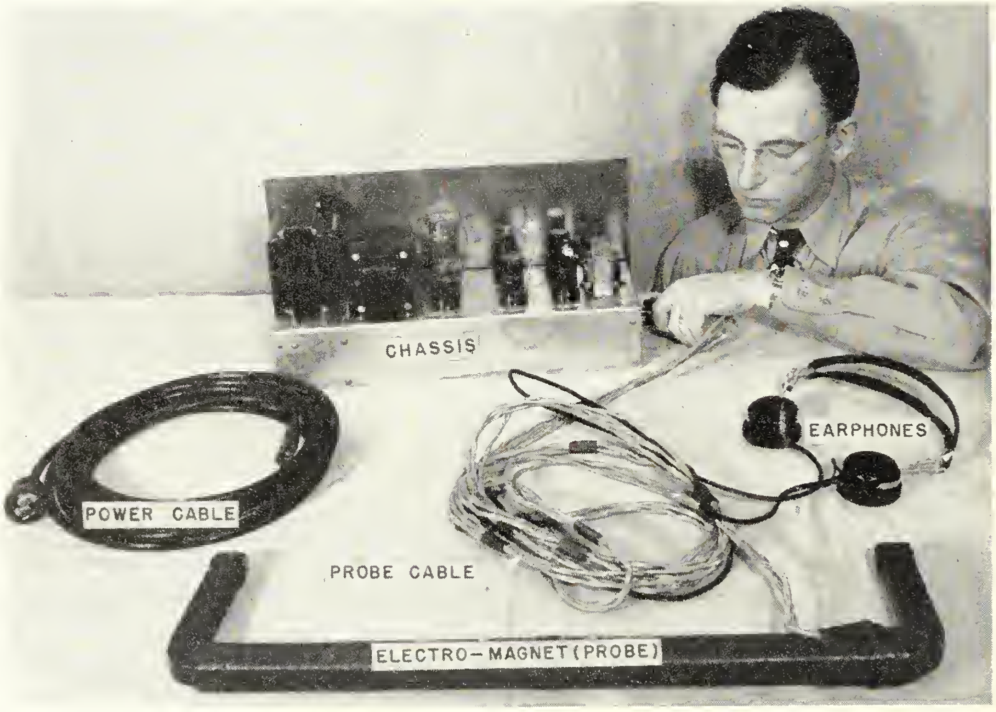
This is only a sample of the better living made possible by the full utilization of hydroelectric resources which adds strength to man's endeavors and causes the lights to shine at Christmas time and throughout the year.

Photograph by H. W. Fuller, Region I.

Power utilization at its most obvious is found here in this modern farm kitchen, with its electric lights, refrigerator, and iron. Pretty soft for daddy, isn't it?

Steel Detecting

How an electronic device for detecting steel through concrete was developed in the Denver laboratories



Component parts of Electronic Steel Detector

Recent field trials at Anderson Ranch Dam of an electronic detector invented in the Denver laboratories proved that the instrument could be used successfully in accurately locating the position of steel reinforcing bars embedded in concrete. The detector was developed as an answer to the problem of drilling holes in concrete without encountering the steel reinforcing bars. While diamond drills employed are capable of cutting through the steel, an appreciable decrease in designed strength may result where numerous or closely spaced holes are drilled into the reinforced concrete. Further, the cost in damaged diamond drill bits is often a considerable item in such operations.

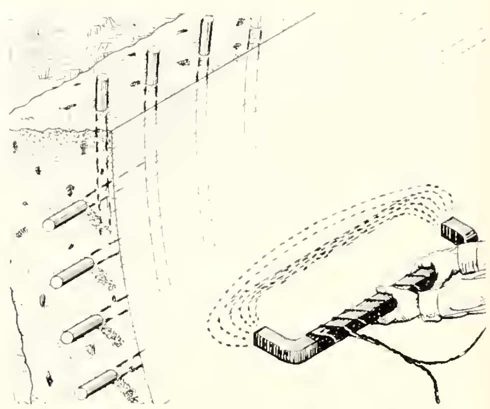
This problem was put before R. F. Blanks, chief of the Bureau's research division in Denver, by Construction Engineer D. S. Walter in connection with the drilling of grout holes through the 2-foot thick concrete lining of the Anderson Ranch Dam outlet tunnel. The tunnel lining is reinforced with two layers of $1\frac{1}{4}$-inch reinforcing steel, each layer consisting of circumferential and longitudinal bars. Spacing between the bars varies with the tunnel section. One of the layers is embedded at a depth of about 5 inches from the concrete surface, the other at a depth of about 18 inches. Could a device be made for locating the steel reinforcement so that it could be avoided in drilling grout holes?

Solution of the problem appeared to be in the field of electronics, so C. R. Daum, of the electronics section, was assigned the job of developing and designing the necessary equipment under the supervision of J. L. Warnock, chief of the hydraulic laboratory. After investigating several methods, the principle of distortion of a magnetic field was decided upon, and the electronic detector was developed and the successful application made at Anderson Ranch Dam. By determining the location of the steel bars within an accuracy of 1 inch, it was shown that the grout holes could be made without encountering the steel reinforcement.

The trials were conducted under adverse conditions by L. T. Cleaver, who was instrumental in building and designing the detector under the supervision of Mr. Daum. Noise from the operation of compressed air drills—which was practically continuous—made it difficult to note tone variations through ear phones used in operation of the device. Further, fluctuations in the 110-volt, 60-cycle power supply which were as great as 50 volts in total variation, affected the apparatus.

In utilizing the principle of a magnetic field, the magnetic field is formed in the concrete by means of a powerful electromagnet held against the surface of the section of concrete under examination. The magnet is connected to a vacuum tube amplifier circuit equipped with earphones. When the energized electromagnet is passed over the concrete surface and the field is cut by a steel reinforcing bar the effective decrease in the length of the magnetic path induces increased voltage in the pick-up coils of the magnet. This results in increased intensity of sound in the earphones.

The essential parts of the electronic detector are a **U**-shaped electromagnet, a four-stage amplifying circuit, and earphones. The core of the magnet is one of laminated construction built up of number 30-gage, hot-rolled, sheet iron strips, $\frac{3}{4}$ inch wide and 36 inches long. A right-angle bend is made about 7 inches from each end of the core to form it into a **U**-shaped exploring probe. The main section of the core is wound with an activating coil consisting of three layers of number 20-gage insulated wire, of approximately 600 turns each, connected in parallel to the 6-volt secondary of a transformer from which nearly 30 watts are supplied as the driving force of the magnet. A pick-up coil of 500 turns of number 36 insulated wire is wound near each end of the magnet, and the voltage induced in these coils is fed into the first stage of the amplifier.



A magnet at work—Operator is guided by the relative intensity of signals through earphones. As detector is directly over, or opposite, the steel bar, sound in earphones is increased to a maximum.

In actual operation the detector is connected to a 110-volt, 60-cycle power source and activated by setting the "off-on" switch on the front of the panel to the "on" position, and allowing about 10 minutes for the set to warm up and become stabilized. The signal control knob is rotated to the right until a strong signal is heard in the earphones, then it is turned slowly to the left until the signal becomes very weak. If the

(Continued on inside back cover)

WEEDS—

and their worthy opponent

"Unconditional surrender" is the campaign slogan of William H. Mercer, whose knowledge of weeds makes him a dangerous front-line fighter

by R. S. BRISTOL

Regional Supervisor, Branch of Operation and Maintenance, Region V, Amarillo, Tex.

William H. Mercer with some of his 1,000 varieties of noxious weed seeds and herbarium specimens.

From the beginning of agriculture, through Biblical ages and up to the present time, man has been pestered by weeds. In every farming region, a heavy weed infestation brands the land and the man responsible for it.

William H. (Bill) Mercer, weed control specialist for the Bureau of Reclamation in Region V, at Amarillo, Tex., who owns what he believes to be the largest personal collection of weed seeds in the world, became interested in weeds long before 1911, when he went to the North Dakota State College of Agriculture.

From the time Bill Mercer was knee high to a Russian thistle, he frequently had heard his father and other leaders of his rural community belabor farmers who permitted their fields to become overrun with weeds. The youth began paying particular attention to obnoxious plants, perhaps with considerable prodding by his father, and studied the undesirable ones in the area. In the years since he roamed the fields around Painted Woods, N. Dak., during his 4 years at State College, while farming on a Reclamation project, and in the time he has been with the Bureau, Bill Mercer has been fighting the unwanted, nonuseful weeds as a preacher fights sin.

Mercer's collection contains more than 1,500 kinds of seed from many of the worst weed patches throughout the world. The collection was obtained on his personal travels, from seed laboratories and through trading with other collectors. Each species and any identifying appendages, such as glumes, awns, and pods, are kept in a two dram glass vial—under lock and key.

The collection represents more than a hobby. Mercer frequently uses it in his educational work and to identify uncommon species brought to his attention in various parts of the country. He adds to the collection as time and circumstances permit, but has no ambition to attempt to assemble all of the more than a half million different types in the world.

Mercer believes the annual loss caused by weeds on some Reclamation projects amounts to more than the farmers pay for operation and maintenance charges and construction costs combined.

About 90 percent of all weeds on cultivated farm lands are planted by farmers who use uncertified seed, according to the specialist. He cites the expenditure of millions of dollars annually to control or eradicate weeds, and joins in the opinion of other authorities who claim weeds are spreading faster than they can be destroyed.

Mercer contends that only greater knowledge about weeds and their damage to the soil and the men who till it can combat the age-old problem. Going about his business of preaching weed control and eradication, he drums up special shows and contests for farmers 4–H and Future Farmers of America clubs, and community garden clubs. His first two major educational events for the fall season were on the Bureau's new Reclamation projects at Tucumcari, N. Mex., and Altus, Okla. He urges farmers everywhere to send their seeds to State laboratories. He teaches farmers, farm boys and home gardeners how to test their crop seed prior to planting.

Give Bill less than half a chance and he will pull a fist full of vials from a pocket, mix all of the different crop and weed seeds together, and dare you to separate them according to kind. Then, with the patience of a man who works with nature, the weed specialist explains how to untangle the different species and return them to their original vials. It is simple, if you know how.

Mercer was associate botanist at North Dakota State College from 1911 to 1916. He then became an employee of the United States Department of Agriculture at San Antonio, Tex. He farmed on the Uncompahgre irrigation project from 1918 until 1930, when he became a staff member of the Bureau of Reclamation.

The expert on weeds and how to get rid of them (if possible) believes man is mighty careless in his dealings with nature. He recalls how a farm woman once planted a few seeds of Burdock which she planned to use in brewing a home tonic of bitters. Within a few years, the whole countryside was infested with the weed. Burdock burrs damaged the wool crop, and cost sheep raisers many thousands of dollars annually.

From the beginning of his existence, man has been fighting weeds, along with personal ailments. He has made progress, but much remains to be accomplished. Success and failure are intermingled with humorous attempts and suggestions. The problem of weeds is no exception.

One unique overture on the subject of weed control cropped out at a recent conference. One of the conferees suggested that aquatic weed growth in irrigation canals and drains might be destroyed by heating the flowing water to the boiling point. The proponent would install electric heating units in the water, bring the water to a boil, and thus destroy the weeds. Doubtless, similar units could be utilized to take the chill off ice before using.

Mercer has little patience with farmers who are careless with the seed they plant. He believes they are enemies to themselves and their country, because of their disregard of the dangers involved. They are, in his opinion, beyond pity.

Photograph through the courtesy of the Nampa Chamber of Commerce.

A WESTERN RECLAMATION AREA PROVES ITS VALUE TO THE MANUFACTURERS OF THE NATION

For a long time the Bureau of Reclamation and other sponsors of irrigation developments in the West have been telling eastern and middlewestern Congressmen what great new markets for nonwestern products are created by the transformation of sagebrush into highly productive farms.

The story has never been told more effectively than by the city of Nampa, Idaho, in the heart of the Boise Valley in the southwestern portion of the State.

It recently staged a "Know Your Own Strength" week in cooperation with Pathfinder Magazine, and for six wonderful days the town was a shopper's paradise, with display windows and counters in 200 stores specially stocked with national-brand merchandise, mostly from nonwestern areas, which goggle-eyed customers bought in record-smashing quantities.

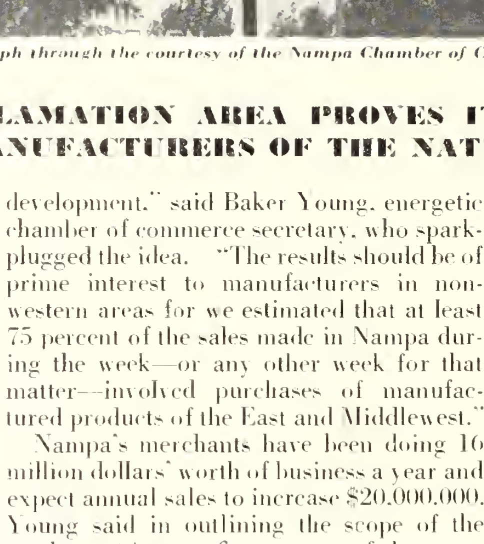
The program offered proof positive of the tremendous buying power of cities in irrigated areas of the West for manufactured products from the East and Middlewest. One needed to travel only a short distance to nonproductive sagebrush wastes which surround the Boise Valley to show in contrast how they offered no market of any kind and contribute nothing to the Nation's wealth.

Sales were tremendous during the gala test period. As compared with business during the same week in 1945, sales in electrical appliance stores rose 1,090 percent; in furniture stores, 287 percent; auto accessories, 250 percent; jewelry, 141 percent; clothing, 139 percent; in department stores, 109 percent; hardware, 93 percent; drug stores, 91 percent; and so on.

"There can be no question of the purchasing power created by Federal Reclamation development," said Baker Young, energetic chamber of commerce secretary, who sparkplugged the idea. "The results should be of prime interest to manufacturers in nonwestern areas for we estimated that at least 75 percent of the sales made in Nampa during the week—or any other week for that matter—involved purchases of manufactured products of the East and Middlewest."

Nampa's merchants have been doing 16 million dollars' worth of business a year and expect annual sales to increase $20,000,000, Young said in outlining the scope of the market. "Seventy-five percent of that market in just one irrigated town is something for nonwestern manufacturers to consider."

Nampa is a thriving city of 13,000 people with a trading area of 74,000, almost entirely dependent on irrigation. It is balanced agriculturally (income: 30 million dollars) and industrially (42 million dollars). The industries are correlated with farming, livestock raising, and horticulture. They include shops for building refrigerated railroad cars, a sugar beet factory, Carnation milk's second largest United States plant, and southwestern Idaho's biggest meat-packing plant.



Photograph courtesy of Pathfinder magazine

CURIOSITY didn't kill interest in Nampa's project.

The "Know your own strength" program sought primarily to prove the tremendous buying power of a typical small city's trading area and the role nationally advertised merchandise plays in holding that buying power "at home." At the same time it disclosed in graphic terms the importance of irrigated development in the West to the economy of the Nation as a whole, through the creation of new markets.

Nampa retailers started the campaign by writing 300 letters to manufacturers and wholesalers "to sell them on what we are worth now and in the future" and to ask their help on merchandise displays. Scores of manufacturers sent new and scarce merchandise to their clients; others sent demonstrations, and sales-promotion material.

To draw attention to the program 6 days of entertainment were provided, including style, automobile, building and electrical equipment shows, railway, air, agricultural and industrial exhibits, a Hollywood premiere, and a 300-station coast-to-coast radio broadcast, featuring the crowning of a queen and Pinky Tomlin singing his new composition "Nampa, Idaho." Other attractions included a buffalo barbecue, music festival, fire-fighting demonstration, dances, parades, and con-

(Continued on page 274)

By bus and airplane, they came to see. . .

Pinky Tomlin sang about it. . .

The mayor put his foot down—in cement—for the movie premiere. . .

Nampa firemen showed their stuff. . .

Photographs on this page through the courtesy of Pathfinder magazine.

Queen Bonnie Lou, along with 8,000 Nampans and their guests, feasted on barbecued beef from four prime Idaho steers. . .

And it all proved Nampa was "up to the minute."

NAMPA, IDAHO, SHOWS I

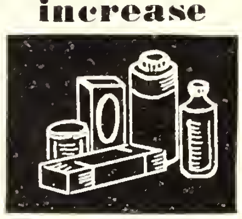
11% increase

AUTOS

55% increase

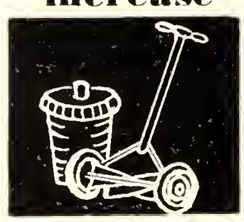
GROCERIES

93% increase



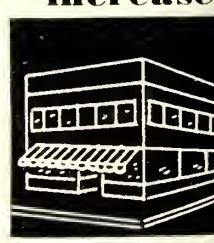
DRUGS

94% increase



HARDWARE

109% increase



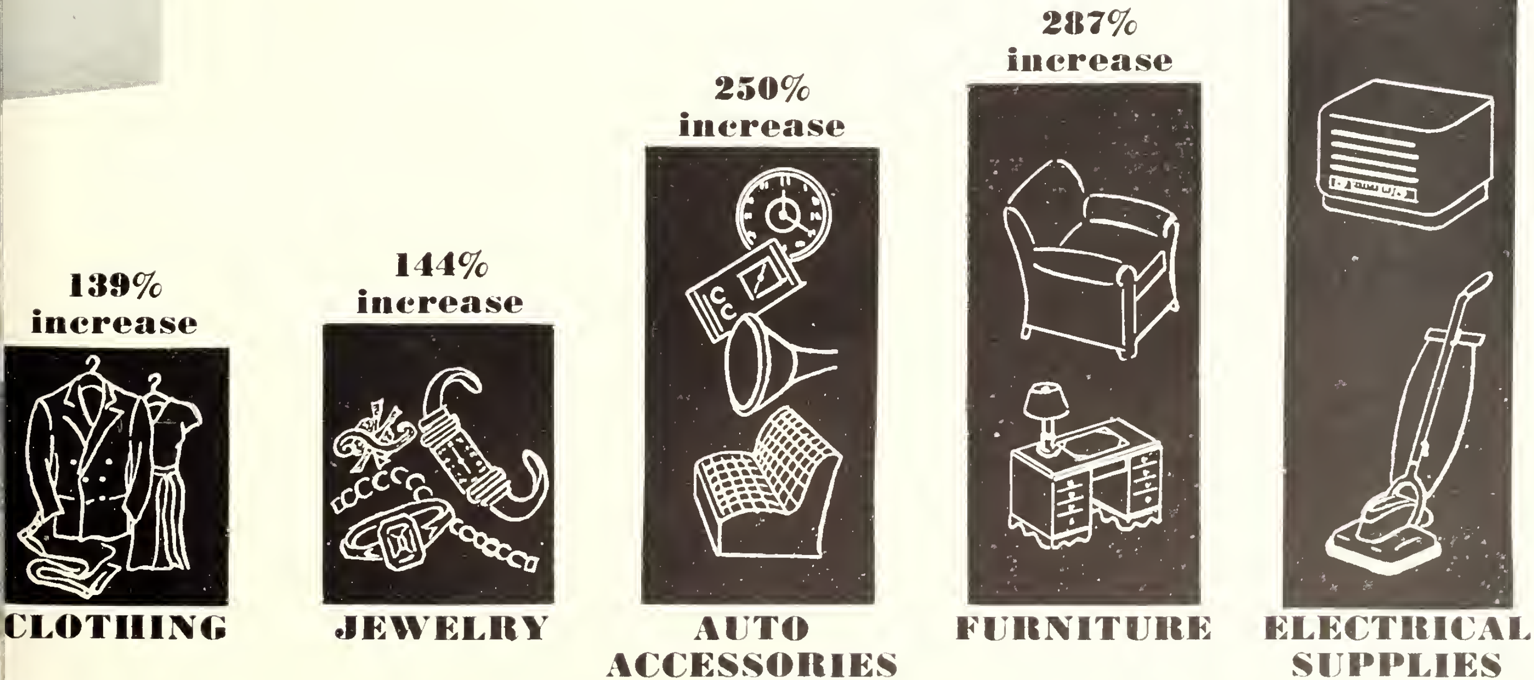
DEPARTME
STORES

How sales increased the week of May 6, I

Over the same week in 1945

S STRENGTH . . . . .

A small town shows big business where its best interests lie



6 . . . . .

Courtesy of Nampa Chamber of Commerce.

FOOD—well-stocked shelves tempted the housewives.

Courtesy of Pathfinder magazine.

AND FURS—the ladies and the merchants were happy.

A Western Reclamation Area Proves Its Value

(Continued from page 270)

certs. A Pathé movie cameraman recorded the affair.

As Pathfinder Magazine put it, many merchants who have never before "tooted their own horns" dug out impressive figures of national-brand sales which they presented to manufacturers. The lumber yard proprietor went after national brands in paint, tools, and insulation; the variety stores after top lines of nationally accepted notions; the shoe merchant after larger allocations of footwear.

All down the line, Nampa's newly awakened merchants—200 strong—demanded attention, outlined the reasons why, and asserted that the manufacturer, retailer, and consumer would profit alike from the unrestricted flow of national-brand goods into Main Street America in general and Nampa in particular.

The magazine has long held that 60 percent of the Nation's population shops in small cities under 25,000 where are located 54 percent of the Nation's retailers. More than 300 cities and towns in this category are situated on or are tributary to the Bureau's 46 operating projects in the 17 Western States.

Cash registers jingle-jangled from morning to closing time once the campaign got under way. Promoters reported one department store's usually dull turn-over on Monday (the first day of the campaign) shot up 250 percent over Saturday. Sales in its drygoods department, stocked with piece goods, skyrocketed to 500 percent.

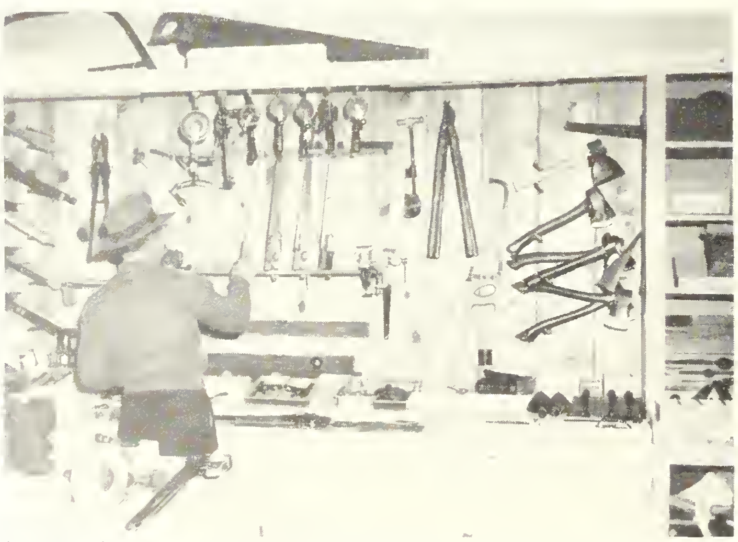
Down the block, the corner drugstore showed a 200 percent increase over the previous Saturday sales by noon of the first day. A newly finished appliance store sold eight home laundries in a few hours. One furniture firm came up with the biggest sales day in company history.

Everywhere in the "Capital of Main Street America"—as Nampa was called in neon lights—buyers took home products from far distant points: Towels from New York, N. Y.; radios from Philadelphia, Pa.; tools from New Britain, Conn.; watches from Elgin, Ill.; cowboy pants from Kansas City, Mo.; and sheets from Salem, Mass.

The campaign was an outstanding success. Its story has been carried in at least 30 national magazines. The American Banking Association requested 14,000 reprints of Pathfinder's article on Nampa "Know your own strength" campaign. Manufacturers, aware of the importance of the program to future sales, sent representatives to Nampa to study the activity. Proprietors of a Stroudsburg, Pa., department store, flew 2,100 miles in their own plane to check Nampa's results first hand.

In addition to the several conclusions reached for manufacturers in the various phases of the program, one definitely stood out as far as Reclamation's contribution to the economic life of the city and the Nation through irrigation development was concerned:

What Nampa has shown—a great market for products the Nation over—every other town on a Federal Reclamation project will show.



Courtesy of Nampa Chamber of Commerce.

TOOLS—delighted the men's hearts and manufacturers' pocketbooks.

Courtesy of Pathfinder magazine.

AND JEWELS—Nampans had a taste for luxuries, too.

INDIA'S UNFINISHED BUSINESS

As in the United States, India Has a Great Opportunity to Realize the Potentialities of Water Resource Development

by W. C. SUMMERS

Engineer, Special Assignments Section, Washington, D. C.

"Most Americans, when they think of India, think of Ghandi, snakes, and the Hindu rope trick."

That India contained items of even greater interest to reclamationists than the above was being proved to a group of Bureau of Reclamation staff members who were making the most of an opportunity to interview A. N. Khosla, Chairman of the Central Waterways, Irrigation and Navigation Commission, and consulting engineer for the Government of India, during his visit with his counterpart in the United States, Commissioner of Reclamation, Michael W. Straus.

English speaking, well-informed Mr. Khosla, who graciously answered questions about Indian irrigation, navigation, flood control, and hydroelectric power indicated that there were great similarities between reclamation problems in the United States and in India.

For example, the topography and rainfall pattern are surprisingly similar, with the western area of India comprising arid and semiarid lands in need of reclamation, and the eastern lands receiving bountiful, but erratic rainfall, making drainage flood control and the development of hydroelectrification the major problems of that area. In the western province of Sind the annual rainfall is from 2 to 4 inches a year, bearing a resemblance to the southwest of the United States and yet this province today has 4½ million acres of irrigated land. In the province of Punjab, land of the five rivers ("Punj" meaning "five," and "ab" meaning "water"), the rainfall varies from 5 to 24 inches a year, indicating extremes in the problems presented by the reclamation area of the United States west of the ninety-seventh meridian. This province has 4½ million acres of irrigated land. India has 16,000,000 acres under irrigation.

The Himalayas, like our Rocky Mountains, are the source of water for irrigation in the north and west. In the south of India, there are rivers which run dry during a part of the year, which caused Mr. Khosla to explain that in India rivers are divided in two categories—those stemming from the Himalayas, and those from the smaller mountains of the more eastern and southern areas which get their water mainly from the Monsoons.

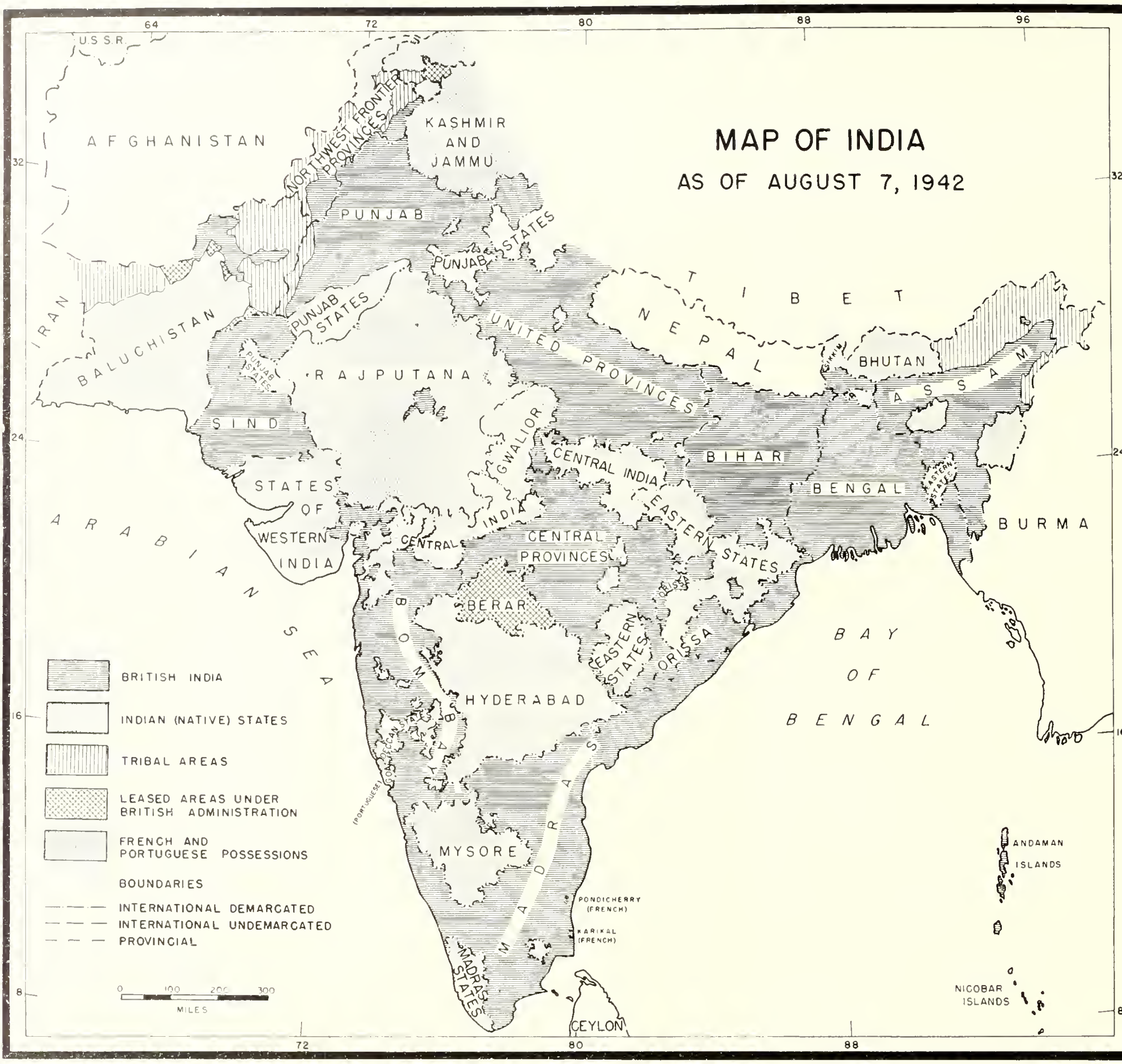
"The people in India are not so different from the people anywhere else," said Mr. Khosla. "They are poor. The standard of living is very low. The only hope of raising it is to encourage irrigation and industry all over the country and get electricity to every village and every home in India."

Two Commissioners talk it over. Michael W. Straus, Commissioner of Reclamation, United States Department of the Interior, and A. N. Khosla, Chairman of the Central Waterways, Irrigation and Navigation Commission of India, during the latter's visit to the United States in October of this year.

They have water disputes in India, too, and their method of settling these disputes is not unlike our "compact" commission procedure. Mr. Khosla modestly outlined the steps which were taken to settle a long-standing dispute among three of the southwestern provinces. This particular dispute concerned the inundation of rice fields during flood seasons and had been fought back and forth through the courts for about 40 years. Although the newly created central waterways, irrigation, and navigation commission only advises the Government of India and the Crown representatives on the principles that should be laid down to govern the settlement of water right disputes between provinces and states, it has already been instrumental in concluding an agreement between the provinces. Mr. Khosla said, "I recently went to each of the main disputants in this case and told them that their interests were common, and they were only fighting over shadows." As a result he worked out an agreement and had each sign it individually. Later he called them all together; they agreed on a solution to the problem; accepted a plan, and ratified what in the United States would be called a water-utilization compact. They still do not agree on who is to pay the damage costs, but Mr. Khosla insists that "now they part as good friends."

The Indian irrigation commissioner pointed out that there was one great difference in the water resource problems of his country and those of the United States. India, with its present 70 million acres under irrigation (as opposed to the United States 21 million acres) will never have to carefully apportion the last drops of water with anxious water-right disputants looking on. Difficult as it is to conceive the fact, India today is now using only 3 percent of its water wealth.

There is another contrast between water resource development in India and the United States so far as the administration is



concerned. The commission headed by Mr. Khosla, working in cooperation with the central technical power board, acts as a central fact-finding, planning, and coordinating organization, advising the central, Provincial, and State governments on all problems regarding waterways, irrigation, navigation, and hydroelectric power. It plans the utilization of water resources for the country as a whole, and in consultation with the Provincial and State governments throughout the country, not only coordinates and encourages schemes for the conservation, control, and regulation of water and waterways, but helps to design and construct projects when the local people are unable to do so themselves. The official policy, however, is to encourage local initiative whenever possible—so long as it conforms to the multiple-purpose concept of basin-wide water resource development which India has admittedly adopted from the Bureau of Reclamation.

This Indian commission makes all necessary investigations in regard to the prevention and control of floods, the prevention of erosion and soil conservation, the prevention of water logging and thur (alkalis) and reclamation of water-logged lands by drainage and pumping, the improvement of drainage, the developments by appropriate Governments of the diversion of water from normal flows of rivers and from storage by dams, and of lift irrigation by pumping from tube wells and deep set streams with cheap power. It also makes necessary investigations toward the development by t appropriate authority of hydroelect power, the development of navigatio facilities and assists provincial or Sta governments (or any river control comm sions or boards that may be set up) in t investigation, survey and preparation water control schemes.

Mr. Khosla's commission sets up prio ties on projects to be undertaken. Fi priority goes to those projects consider essential to life—food growing areas wh irrigation is needed to prevent famine. Se ond comes projects intended for protecti similar to the Central Valley project a others where a supplemental supply of wa is needed to maintain a well-rounded ag cultural economy. The lowest priority

given to projects in areas which are self-sufficient, but water supply irregular. As Mr. Khosla explained, "in these areas, irrigation will increase their productivity so that the people can export their goods. In our case in India, it is necessity first and profit last."

The Indian commission, now in the process of framing a water law for India, is setting up a memorandum on water rights, collecting information from the irrigation areas of the world.

Asked about construction methods employed on reclamation projects in India, Mr. Khosla explained that three categories of procedure were followed. The first is construction by government force account employees which in India is considered most economical and effective as it enables the engineers to gain varied and continual experience necessary to insure the development of increasingly effective modern methods.

Under this system, contractors supply day labor, and the Commission issues materials which are purchased from firms and passed on to the contractors. The second method is under an inclusive contract whereby both labor and material are furnished by one contractor. Under the third method, similar to that in effect in the United States, construction schedules are announced, and bids are awarded to various contractors to construct certain portions of the project.

On the question of mechanization versus manpower, Mr. Khosla cited the vast difference in the balance between machine and man in India, where labor is plentiful and cheap, 50 cents a day being the approximate average wage for a worker on a construction gang. The Indian official pointed out that there were certain cases where mechanization was necessary, but because their program is twofold—first, to give employment to the people and second, to develop the country, manpower rather than machine-power is of primary consideration.

Irrigation in India has proven its benefits to the people, as it has proven itself in the United States. The history of Indian irrigation covers a much longer period, but extensive and modern irrigation practices date from about 1850 only a few years before modern irrigation in the United States began.

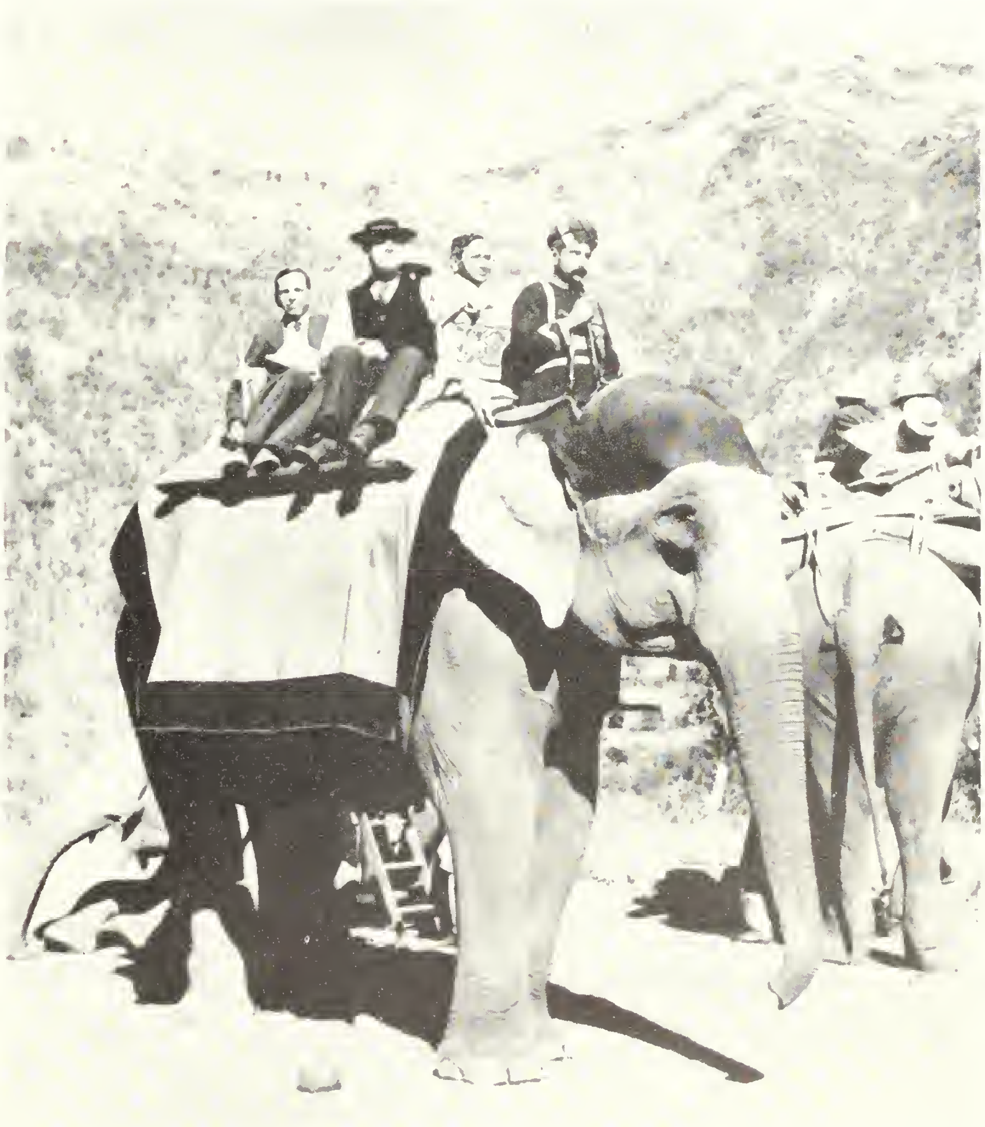
According to Mr. Khosla, irrigation has been practiced in India from the time cultivation began, and very high techniques have been developed. Wells have been in use from time immemorial and in Southern India innumerable tanks of great antiquity can be found. Drawing off the flood waters of the Indus and its tributaries for the irrigation of Sind and parts of the Western Punjab has been a practice followed from very early times. In the foothills of Northern India can be found the traces of ancient irrigation channels which have been buried for centuries in the undergrowth of the forests. Irrigation under tube wells has developed to a large extent in North India. The "falls" of the Upper Ganges canal have been utilized to generate power to drive pumps of tube wells. Here 1,550 tube wells, each producing 1½ cusecs (cubic feet per second) irrigates 670,000 acres every year. The cultivators, or irigation farmers, pay according to the amount of current used, which encourages economy and efficiency. Twelve and a half million acres are supplied by water from wells in India.

Prior to the days of the British rule, little had been done in the direction of construcing really large works, the three most notable exceptions being two canals from the Jumna, both of which had, however, fallen into disuse, and the Grand Anicut, a weir in Madras diverting the Cauvery water into the delta lands of Tanjore, and which, according to tradition, was constructed by the Chola Kings about 1600 years ago.

As in the United States, geographical conditions in the various parts of India are very different and the sources of water supply and methods of irrigation also vary.

The north of India is an area of flat plains traversed by wide rivers. The rainfall is in general poor, hence the need for irrigation; but in the hot dry summer months, when the snows melt on the Himalayas and there is heavy rainfall in the foothills, the rivers swell into floods. "That is when the damage is made," commented Mr. Khosla.

The early canals took off from cuts in the river banks, flowing when the rivers were in flood, but drying up in the winter. Some of these early canals remain, but supplies are now mainly drawn from weirs and barrages across the rivers. In India the word "dam" applies only to storage structures. "Barrages" (comparable to our diversion dams) extend all the way across the stream and have flood gates extending the full length of the structure, whereas "weirs" have no gates, but may have flashboards. The gates of the barrages are opened to allow the flood discharges to pass down the river, but are closed when the river falls, so that the reduced flows are diverted into the canals. Supplies are thus maintained throughout



On the way to the Chandi Dam site in India, John L. Savage, Mr. Ramgopal, Revenue Minister, Mr. Khosla, and Mr. Kritchley use ancient transportation methods while discussing modern reclamation developments.

the year, as a result both summer, winter, and perennial crops are irrigated. The largest system of this kind—which Mr. Khosla believes to be the largest single irrigation system in the world—stems from the Sukkur Barrage across the river Indus, in Sind, with its 6,700 miles of waterways. The barrage consists of 66 spans of 60 feet each, with electrically operated gates. The seven canals—three on the right bank and four on the left—draw a combined discharge of 46,000 cusecs. Already irrigating over 3 million acres, they are designed to supply 5 million acres, about 8,000 square miles.

In the south of India the system of weirs across the Godavari River in the Province of Madras when constructed about 1850, was considered to be a bold advance on anything previously attempted in that line. Here the land is undulating and hilly, most canals are fed from reservoirs, and the weirs constructed across the rivers feed the canals which irrigate large areas. The Godavari river drains an area slightly greater than that of the State of Utah and its maximum flood discharge rises to an enormous volume of 2 million cubic feet per second, twice the capacity for which Grand Coulee Dam was designed.

The Polavarum Dam, a structure as large as Grand Coulee Dam, is being planned across the Godavari River. This will irrigate an area more than twice that contemplated for the Grand Coulee project.

There are no dams as high as the gigantic Boulder Dam in the United States, but many in Bombay, Madras, and Mysore are a mile or more in length and over a hundred feet high. Wilson Dam in Bombay is 270 feet high.

In India, too, the benefits of irrigation to the country cannot be measured in terms of money alone. As in America, irrigation improves the yield of crops and enables valuable crops, such as sugarcane, to be grown where not otherwise possible. It increases the national revenue directly and indirectly. But the greatest benefits are the increased prosperity of the people, which has a far reaching effect throughout India, and the protection of large areas against famine, starvation, and ruin, which used to follow years of poor rainfall.

As an example, the Periyar project rendered one of the most precarious and frequently famine stricken tracts of the Madras Province practically free from want.

The most remarkable development of irrigation is in the Punjab. Until the introduction of irrigation, practically the whole vast stretch of the country was desert waste, extraordinarily devoid of animal life. Stunted shrubs formed the sole vegetation. Except for a few nomads the tract was uninhabited. Indian engineers have now converted this region into one of the finest agricultural areas in the country. With the introduction of irrigation, the new areas were fully colonized by transporting whole communities into them.

The Bhakra Dam in Punjab, now being designed by the International Engineering Co., of Denver, Colo., calls for a concrete dam approximately 480 feet high and will be constructed across the Sutlej River in a narrow gorge near Bhakra. The reservoir formed will thus protect and irrigate four and a half million acres in the south and southeastern area of Junjab. This project is expected to generate 160,000 kilowatts of power.

The Lower Swat Canal in the North-West Frontier Province provides another proof of the value of irrigation. In 1875 when surveys were being made, the tract was a barren wilderness, uncultivated and almost unculturable, treeless and desolate, into which no one dared to go unarmed. By 1895, only 20 years later, the tract was a wide expanse of cultivation dotted with villages occupied by a law abiding and contented peasantry.

From the description of irrigation techniques in India by Mr. Khosla, it was apparent that Americans could learn a great deal from their time-tested and continually expanding techniques in this field. Their problems in the field of water rights also strike a common chord of interest, as does their interest in hydroelectric power dedevelopment. Already Dr. John L. Savage, world-famous designing engineer, has visited India and found its irrigation and hydroelectric potentialities so favorable that Indian engineers and scientists have asked him to return for additional conferences.

Mr. Khosla, in returning to the United States for the second time (his first visit was in 1939) to tour the reclamation areas of the United States, insisted that he feels very much at home, saying, "The basic problems are the same."

Photogragh by William S. Russell, Region III

Boulder Visitor No. 2,000,000.

One in Two Million

"It is the most exciting thing that has ever happened to me," exclaimed 18-year-old dancer Maria Krusoff, of Oak Park, Ill., when she learned that she had bought the lucky ticket and was entitled to a special tour through Boulder Dam. Miss Krusoff stopped to see the famous structure on September 29 with her father and brother en route to Malibu Beach, Calif., where she will study professional dancing. Here she is congratulated by Director of Power C. P. Christensen, Boulder Canyon project, who explains that she is the two-millionth visitor to take the guided tour through Boulder Dam since Bureau of Reclamation guide facilities were instituted in January 1937.

TIME TO MODERNIZE

Omaha Convention of NRA Provides Setting for Plea to Liberalize Reclamation Laws

The National Reclamation Association Convention in Omaha, October 9–11, was high-lighted by the appeal of Commissioner Michael W. Straus for modernization of the reclamation law of 1902. The convention was largely attended from the 17 Reclamation States, spirited addresses were made, and the way paved for bringing greater national recognition of Reclamation benefits.

In his hard hitting speech Commissioner Straus charted the future course of Reclamation when he explained that in 1902, when the basic reclamation law was written by leaders of the West under Theodore Roosevelt, it was a liberal law conceived chiefly for single-purpose local irrigation projects. He stated that it remains the basic law today, but what was so forward-looking that it was almost revolutionary in 1902 has, in some aspects, become so static that it is perhaps reactionary in 1946. Continuing on this theme, he said "a law which served well to aid the easy and simple local single-purpose project, now all built, is not a modern instrument of legislation for today's and tomorrow's complex multiple-purpose projects which must be conceived and executed on a valley- or basin-wide scale to meet, as they must meet, the demands of your States. Reclamation's famed engineers can only function within the area permitted them by the laws that set their tasks."

Keep Time-Tested Laws

Straus assured the members that Reclamation does not advocate abandoning any of the time-tested and sound fundamentals of reclamation law, including the tenet that those benefited should contribute to the expense in accordance with their rewards and their ability to pay.

"Today, as our country fills up," he said, "there is increasing and undeniable interest in the development of our recreation and fish and wildlife resources. This growing demand should not be contested but should be well-served at future multiple-purpose reclamation reservoirs. They offer this opportunity without detriment to irrigation. So, during the last days of the Seventy-ninth Congress, we obtained a new law (Public Law 732) which authorized allocations on a basis that the irrigator need not repay that part of the cost of our reclamation projects that can properly be allocated to benefits to fish and wildlife."

Warming up to his subject, he said, "*Why* now should the reclamation laws not be amended in the same way with respect to purely recreational features of a reservoir so that these benefits are achieved without saddling the expense of the vacationist or the nature lover at reclamation reservoirs on the local water users—as required by present law? The answer, of course, is that such action is due. The Bureau of the Budget and the President have already approved a proposal by Reclamation to have recreation benefits allocated as nonreimbursable national benefits, thus lifting this fiscal burden from the backs of the irrigationists. With proper attention of the Western States, this proposal, already approved as to language, will pass Congress and become law. But the modernization of the reclamation laws should not stop there."

"*Why*, for an example of inconsistency, should the United States charge western power users 3 percent interest for investments in developing the power of rivers right in our country here while the same United States lends billions of dollars at less than 2 percent interest to countries all over the world for the same and other purposes thousands of miles from our homes? I am satisfied that our reclamation power interest rate should be lowered to at least 2 percent. We are discriminating against ourselves and must continue to do so under the present laws until you change them.

"*Why* should we insist, as the law now does, that water users return all allotted costs of construction in 40 to 50 years for dams, reservoirs, and canals with a proven useful life of 100 or 200 or, for all we know, thousands of years? Railroads, power companies, and other public service corporations are set up on a perfectly proper and legal basis that provides financing contemplating repayment only within the useful life of the works built. Of course, they generally never repay their construction investment but merely keep their plant in shape and then refinance and refinance all within the useful life of the works. That is considered sound practice. *Why* does the great United States, when it undertakes to aid its own citizens develop their own national resources, impose such harsh terms? Reclamation must—until the law is changed. You can speed that change.

"*Why* do we take an astigmatic view of Federal irrigation? Why, when we study its place in our economic picture, do we look through the wrong end of the spy glass? Legislative-wise we keep our books

Photograph courtesy of The Omaha World Herald.

Pioneers of the coordinated Missouri Basin development plan—Brig. Gen. Lewis A. Pick, Corps of Engineers, War Department, and Assistant Regional Director W. G. Sloan, of Region VI.

on the basis that any balances due on a project—on Boulder Dam or Coulee Dam—are debts. But in balancing the books we seem to be blind to the fact that these and similar capital investments on the other side of the ledger become credits, ranking without challenge among our most productive national assets. We have drifted into some sort of corkscrew thinking whereby after we proved it sound to first develop our national strength and wealth by giving away, for free, some 130 million acres of our Federal treasure to the railroads which opened the West, now we act as if it is unsound to secure our national strength and wealth in the West with our Federal treasure, even when Uncle Sam keeps title to the works built, unless under an advance contract it be paid back in 40 years by water and power users. When irrigation creates from the desert or sagebrush a Phoenix, a Boise, a Scottsbluff, or, specifically, a Yakima—on which an investment of 37 million dollars over a period of years brought back in the single year of 1945 crops worth 78 million dollars—are we or are we not broadening the tax base? Is the wealth created at a Yakima taxable or not—and *is it taxed?*

"*Why* is not that hard-cash form of Federal tax revenue, resulting directly from Federal irrigation and as nonexistent as water in the desert without irrigation, entered on Uncle Sam's books when Reclamation's account is cast up? Do, or do not, these reclamation communities open new markets to pour revenue into the national tax treasury of the United States of America, not to mention the *taxed treasuries* of the United States Steel Co., the United States Rubber Co., the American Telephone & Telegraph Co., the American Tobacco Co., the National Biscuit Co., the National Cash Register Co. (and let us not overlook those distinguished supplemental irrigators, the National Distillers Co.), and all the rest of the star-spangled corporate galaxy that collectively form our economy. Can we afford not to build these reclamation projects and broaden our tax base? Can we halt inflation and balance the budget without creating this real new wealth? *Why* do we not recognize these facts in our laws?

"For a number of years now, the United States has considered expenditures to control floods-expenditures in the national interest to be paid from the national treasury and not by the local beneficiaries. Of course, this has naturally lured many localities to disguise irrigation developments as flood control proposals with frequently sad results. But what no one can explain is *why* in the name of logic, consistency, or wisdom, it is a local reimbursable benefit for which the farmers should pay to aid agriculture by putting water on acres, and at the same time it is not a local but a national and nonreimbursable benefit for which the farmer should not pay to aid agriculture by holding water off acres—frequently the same acres at different seasons.

"And by the same token, will someone please tell us why flood control is, under our laws, a national and nonreimbursable purpose, and silt control which is vital in the Southwest is not so considered? They are both tremendously damaging except that one happens to be a flood of land and the other a flood of water.

"Please understand me clearly. I make no criticism of the flood-control laws. But I for one would like to see the same standards applied to wealth-creating irrigation which happens to be what is needed in the dry but fertile West. The last Congress started a reexamination of the reclamation laws. The undertaking will be resumed by the next Congress. *Now is the time to modernize the reclamation laws.* Our ability to discharge the tasks we have undertaken in great measure rests on further development of the ever-evolving reclamation laws that are both our legal foundation and our actual ceiling."

In concluding his address, Commissioner Straus said, "give this matter your full attention and wisdom in the coming months so that we may be enabled to go forward undeterred to our mutual goal of putting all the available water in the arid West to useful work."

Among the most significant resolutions adopted by the convention were the reaffirmation of the association's position at the 1945 convention with reference to the application of power revenues in fixing power rates on reclamation projects. The resolution authorized the appointment of a committee "to make a study of benefits from reclamation project and basin-wide development . . . the problems and appropriate policies incident to economic justification of such undertakings, and in addition, to study any related reclamation problems." The committee is to confer with the Secretary of the Interior, the Bureau of Reclamation, members of Congress and others, and interested citizens, to assist in accomplishing the purposes set forth in the resolution.

The association also endorsed the Senate Appropriations Committee's interpretation of Public Law 478 on utilization of power revenues which provided for the application of these revenues to reduce the cost of water service.

In addition to these the association restated its position of past conventions in opposing the acreage limitations provisions of the reclamation law and valley authority legislation. It also renewed its appeal for full compliance with State water laws in construction of Federal projects.

Former Commissioner Harry W. Bashore, of the Bureau of Reclamation, addressed the convention on "What irrigation means in the Great Plains area." while Assistant Commissioner William E. Warne in his talk outlined plans for immediate development of the second stage of the Colorado River Basin program.

The convention had the benefit of the opinions of many of America's foremost authorities on natural resource development as well as a representative from Canada. Among the 800 visitors registered were Senator Carl A. Hatch, of New Mexico, who was the principal speaker at the convention banquet; Senators Hugh Butler of Nebraska, Chan Gurney of South Dakota; Representatives Carl T. Curtis and Arthur L. Miller of Nebraska, Ben F. Jensen of Iowa; as well as additional representatives of the Bureau of Reclamation, Corps of Engineers, War Department, Agriculture Department, and other agencies and organizations.

OFFICERS AND SPECIAL COMMITTEES APPOINTED AT NRA CONVENTION

Officers

Judge Robert W. Sawyer, Oregon, president

Harry E. Polk, North Dakota, first vice president,

Judge Clifford H. Stone, Colorado, second vice president

Don McBride, Oklahoma, secretary-manager

Executive Committee

Judge Robert W. Sawyer, Oregon
Harry E. Polk, North Dakota
Judge Clifford H. Stone, Colorado
W. F. Wilkerson, Wyoming
Fred E. Wilson, New Mexico

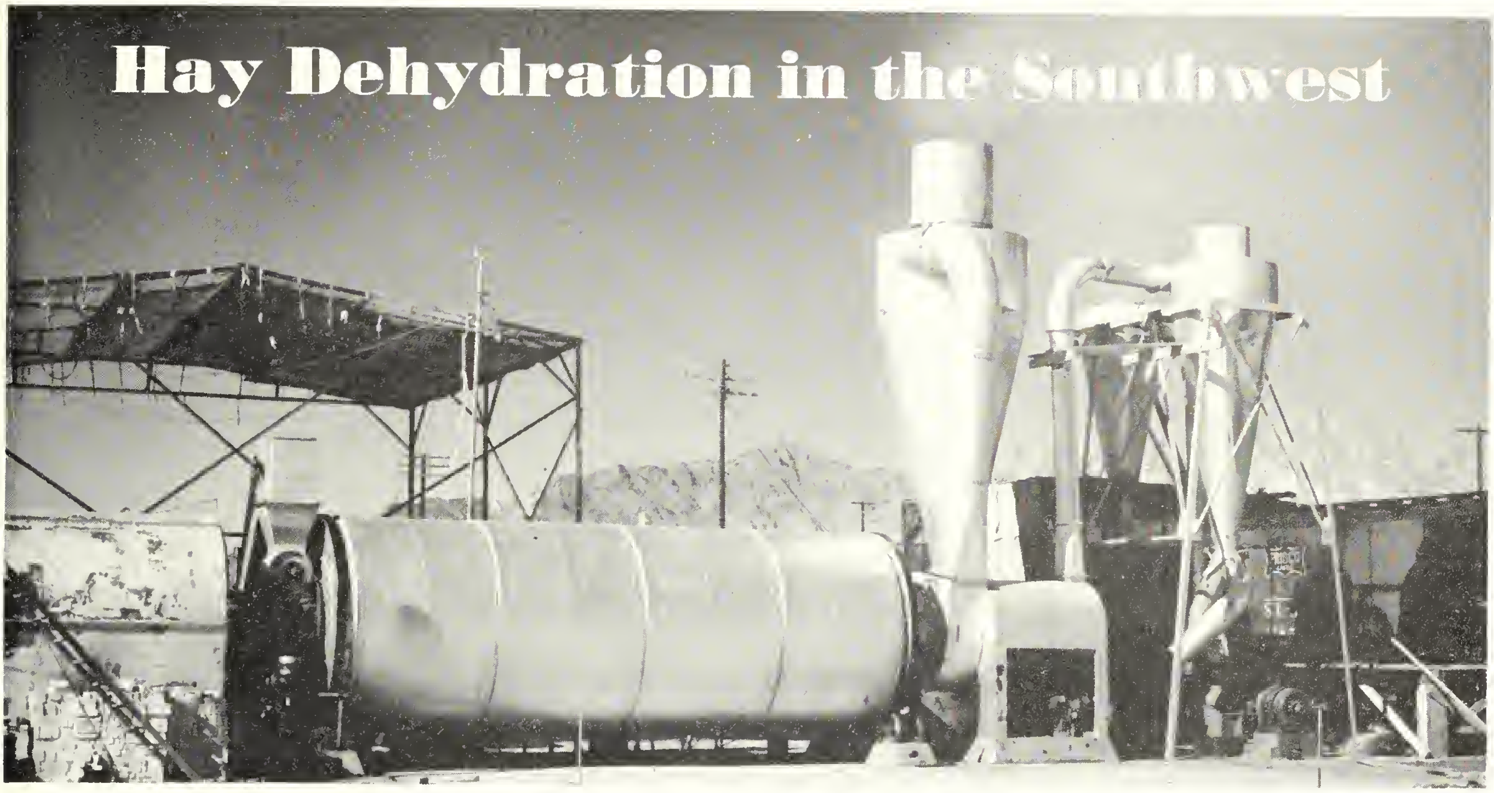
Committee on Land Limitation

Jean Breitenstein, Colorado
Gilbert Jertberg, California
J. E. Sturrock, Texas

Study Committee

Judge Clifford H. Stone, Colorado
Fred J. Frederickson, North Dakota
F. O. Hagie, Washington
J. H. Moeur, Arizona
E. W Rising, Idaho

Hay Dehydration in the Southwest



Photograph by Harry W. Myers.

Yuma Alfalfa Fields Undergo a Quick-Drying Operation by Modern Methods

by JOHN A LEVERITT

Davis Dam project, Region III, Boulder City, Nev.

The modern method of preparing alfalfa for livestock and chicken feed by dehydration is being used for the first time in the Southwest on the Bureau of Reclamation's Yuma project near Blaisdell, Ariz. The dry desert air increases the efficiency of the dehydrating plant, making the operation even more successful than in other sections of the country.

Early this year the W. J. Small Co., Inc., of Neodesha, Kans., moved a dehydrating plant from Charleston, Mo. to Blaisdell and it has been in constant operation since. The plant has a rated capacity of 20 tons each 24 hours, but the extremely dry air of the desert has made it possible to process as high as 30 tons a day.

In addition to the increased efficiency of the plant, the operation in the Gila Valley of Arizona has another advantage. The growing season is 12 months, permitting operation of the plant all year. In this manner the cost of the plant can be amortized in a much shorter time.

A complete change in marketing the alfalfa has become necessary for farmers selling their crop to the Small Co., and there is still a debate among the farmers as to the relative economy of dehydrating the hay or selling it in the conventional way. Before comparing the different marketing methods, here briefly is a description of the dehydrating process.

The hay is dried by hot air. The air is heated in a fuel-oil furnace to a temperature of from 1,200° to 2,000° F., depending on the moisture content of the alfalfa. Suction fans draw the heated air and the hay, which is especially chopped for the process, into a 25-foot drum. The drum is divided into three sections and therefore the hay actually travels 75 feet in the drum and remains from 3 to 5 minutes. It leaves the drum at a temperature of from 250° to 300° F.

From the drying drum it travels through two cyclone dust collectors where it is cooled and the air separated from the hay. The second dust collector feeds the hay into a hammer mill where it is ground into a fine, green flour. From the mill the flour goes to a third dust collector and the air is separated from the ground alfalfa. It is then packed in 100-pound bags for shipment.

This method of treating the alfalfa preserves much of the food value of the hay otherwise lost, particularly the vitamin content. It is considered an excellent food for chickens and other livestock. It is said that some people think that alfalfa tea and alfalfa bread are great delicacies.

The debate among the farmers is caused by the different methods of harvesting the hay. Normally, the farmer cuts his alfalfa, dries it in windrows, bales it, and then sells the baled hay. Hay for dehydration is sold uncut in the fields for about 20 percent less per ton.

Recently, Ray Harvey, a farmer near Blaisdell, approached the problem with an open mind. He sold 60 acres of alfalfa to the Small Co. and at the same time harvested 60 acres himself. The company completed its cutting operation in 4 days and on the fifth day Harvey irrigated that field and started another crop. It required 12 days to cut, dry, and bale the other 60 acres in the conventional way. The tonnage from both fields ran approximately the same.

At the time, the price in Yuma for the baled alfalfa was $28 a ton and the Small Co. was paying $22.50 a ton. Harvey decided that the returns from the two fields would be about the same, considering the savings in harvesting and the 8-day growing start given the alfalfa in the field cut by the Small Co.

Those farmers not sold on the dehydrating process argue that the return from baled hay is greater. Another argument advanced is that operations of the Small Co. damages the borders around the field, making it necessary to repair them before water can be applied to start the next crop of alfalfa. Regardless of the economics of the dehydrating process, the company has been able to purchase all the alfalfa the plant could process.

Letters to the Editor

Gold in the Silt?

SEPTEMBER 30, 1946.

DEAR SIRS: Was reading with much interest your story "Corralling the Colorado" in the September issue. Was especially interested in that part headed "Silt Creates Problem."

It is interesting to speculate on what methods may some day be used to prevent our dams along the river from filling with silt. No doubt methods which now may seem fantastic.

Of course, some of this will be taken care of through erosion control. However, it seems to me some of it could be used to good advantage by pumping back on our land or by farming new lands. The water used to carry the silt could be used to irrigate the new land farmed. Years ago the river carried much gold. It is still carrying some? If so, perhaps enough could be caught to help pay the operating expenses.

I am not an engineer. I am a farmer living on the Reclamation project in Grand Valley, Mesa County, Colo., and glad of it. Just spent 4 years in the Army and it is good to be back where I can see water running instead of blood.

Sincerely,

LEO KIEFER,
Mack, Colo.

(Editor's Note: The Bureau of Reclamation is starting a wide scale silt program which will be featured in future issues of the ERA. Reader Kiefer's reference to gold is interesting, and Bureau engineers state that it is standard practice in all dredging operations to recover any valuable minerals that may be present in the removed materials, provided the value of such minerals is sufficient to warrant their extraction.)

A Boost From Berkeley

OCTOBER 28, 1946.

DEAR SIRS: The ERA is not only most informative, but articles are written in a very interesting style. The September and October numbers unusually so. I do enjoy reading your News Round-up. Keep it up.

It would be nice if you could let your readers know just what the United States Interior Department is doing each month as to power development at their various river and flood control dams.

Sincerely,

WILLIAM HOFFMAN,
3120 Telegraph Ave., Berkeley 5, Calif.

(Editor's Note: Reader Hoffman's request for power development stories will be kept in mind. More power to him!)

For Your Art Collection

Write to the Bureau of Reclamation, Department of the Interior, Washington 25, D. C., for photographs suitable for display or framing which appear in this issue.*

	Selling price (each)
CONTACT PRINTS (single weight glossy paper, **available only if size of negative permits**):	
4 x 5 (or smaller)	$0.15
5 x 7	.20
8 x 10	.40
ENLARGEMENTS:	
4 x 5 (or smaller) single weight glossy	.25
5 x 7 single weight glossy	.40
8 x 10 single weight glossy	.60
11 x 14 single weight glossy	1.25
11 x 14 double weight mat	1.50
16 x 20 double weight mat	2.50
20 x 24 double weight mat	3.00
24 x 30 double weight mat	5.00
24 x 36 double weight mat	6.00
30 x 40 double weight mat	8.00
	Per sq. ft.
Over 30 x 40 double weight mat	$0.85

Recent Project Maps

Published by the Bureau of Reclamation

Western half of the United States showing Reclamation projects and the 7 regions. Map No. 44–14, revised October 1945. Size 16 x 20 inches. FREE.

Orland project, California. Map No. 45–45, (supersedes No. 21880). Blue, green, and black. Size 8 x 10½ inches, price 10 cents.

Grand Valley project, Colorado. Map No. 45–40, (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 x 26 inches, price 25 cents.

Klamath project, Oregon-California, Map No. 45–52, (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 x 20 inches, price 25 cents.

**Note.*—In ordering maps, or photographs, please do not send postage stamps. Make check or money order payable to the Treasurer of the United States and address your order to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

Motion Pictures

The Bureau of Reclamation distributes 16 mm. motion pictures relating to its activities. The films will be loaned the borrower willing to pay the express charges both ways. The list follows:

(Distributed from the Bureau of Reclamation Office, Washington 25, D. C.)

Boulder Dam	5 reels	(silent)
Boulder Dam	4 reels	(sound)
Reclamation in the Arid West	1 reel	(sound)
Fundamentals of Irrigation	3 reels	(sound)
Irrigated Pastures (Kodachrome)	2 reels	(sound)
Fighting Weeds (Kodachrome)	3 reels	(sound)
Measurement of Water (Kodachrome)	3 reels	(sound)

Reclamation Reading

The Origin, Distribution, and Air-Photo Identification of United States Soils—With Special Reference to Airport and Highway Engineering—By D. S. Jenkins, Civil Aeronautics Administration (now of the Bureau of Reclamation), D. J. Belcher, L. E. Gregg, and K. B. Woods, Purdue University—Technical Development Report No. 52—May 1946. U. S. Department of Commerce, Civil Aeronautics Administration, Washington, D. C. Price $2.00. Superintendent of Documents, Government Printing Office, Washington 25, D. C.—This volume is intended to serve chiefly as a comprehensive engineering handbook on soils in relation to airport and highway construction and the use of aerial photographs in determining soil and geologic characteristics of airport sites and highway locations, but it also includes information that would be useful to reclamation engineers. Excavation estimates can often be made with accuracy from air-photo identification of the soil and rock characteristics.

Labor Unionism in American Agriculture, by Stuart Jamieson, lecturer in economics, University of British Columbia, published by the Bureau of Labor Statistics, Department of Labor, Bulletin 836, June 1945: 457 pages of text with bibliography. A report on the development of unionism in agriculture in the United States, tracing the changing character of agriculture in this country and the conditions that have given rise to labor unrest. Seventy cents a copy from the Superintendent of Documents, Washington, D. C.

FOREIGN ENTRIES

Furrow Irrigation of Community Settlements, by A. V. Lyon, officer in charge, commonwealth research station, Merbein, Victoria, and R. R. Pennefather, officer of the irrigation research station, Griffith, New South Wales, Commonwealth of Australia, in the Journal of the Council for Scientific and Industrial Research, Melbourne, Australia, February 1946, page 38. A technical study of furrow irrigation of community settlements prepared for the Irrigation and Drainage Committee for South Australia. For information write to G. A. Cook, Secretary, Council for Scientific and Industrial Research, 314 Albert Street, East Melbourne, Australia.

Concrete Expansion Due to Alkali-Aggregate Reaction, by L. Boyd Mercer, Melbourne engineer, in The Commonwealth Engineer, Melbourne, Australia, June 1, 1946, page 337. Study of a simple method for the recognition of dangerous cement-aggregate combinations, based upon the distortion produced in a body undergoing differential expansion. The Commonwealth Engineer is published monthly by the Tait Publishing Co., Ltd., 349 Collins Street, Melbourne, Australia.

NEWS ROUND-UP

Reclamation in Education

In cooperation with the Women's Conservation Council of Utah and the University of Utah, the Bureau of Reclamation is participating in a common educational endeavor, the Conservation-Education Workshop at Salt Lake City.

Yakima Costs Determined

Cost determinations of Yakima project storage works have been completed and the proportionate share allocable to the Wapato Indian irrigation project set at $1,511,512. Under the act of August 1, 1914, $635,000 has been paid into the reclamation fund to date.

Bear River Negotiations

President Truman has appointed Regional Director E. O. Larson of the Bureau of Reclamation to be Federal representative in compact negotiations between the States of Utah, Idaho, and Wyoming for division of the waters of the Bear River.

Lineweaver Addresses North Dakota NRA

Director of Operation and Maintenance, Goodrich W. Lineweaver, in a speech at Williston, N. Dak., stressed the importance of repayment contracts in connection with the Missouri Basin Development. He pointed out that while plans had been made for the expenditure of more than half a billion dollars in this area for the development of the Valley resources, rising construction costs must be met. The law requires the repayment of such expenditures. He said that the time for realization was at hand.

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In lieu of the bronze plaque originally proposed, a rustic sign honoring Buffalo Bill has been approved for erection at the Buffalo Bill Dam on the Shoshone project.

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Reclamation's Chief Geologist Roger Rhoades has been named by the State Department as a technical adviser to the United States Delegation to the Second Pan-American Conference of Mining and Geology at Rio de Janeiro, Brazil. Mr. Rhoades left Washington en route to Brazil September 26.

Death of Judge Austin

The death of W. C. Austin, southwestern Oklahoma pioneer and "father" of the Lugert-Altus irrigation project—easternmost ever constructed by the Bureau—has taken from the ranks one of the most ardent supporters of reclamation. The veteran attorney succumbed October 5 at his home in Altus, Okla.

A former State senator, Austin was a member of the State planning and resources board and president of the Oklahoma Reclamation Association at the time of his death.

Efforts to construct an irrigation project east of the ninety-seventh meridian, initiated at the turn of the century, were brought to a climax during the Great Plains drought in the thirties under Austin's leadership. Thousands of "Dust Bowl" farmers had lost their homes and were migrating westward.

Austin, with the cooperation of other area leaders, including W. B. Gover, H. T. Kimbell, Elmer Garnett, and Harrington Wimberly, revived plans for the Lugert-Altus project and the Bureau of Reclamation completed surveys begun originally by the Corps of Engineers.

Preparation of legislation and its guidance toward project authorization was handled by Austin, who also was instrumental in an election March 29, 1940, to organize an irrigation district. The election carried 333 to 42.

Construction of the 60,000-acre project began in 1941. It was suspended during the war, but was resumed in April 1944 upon recommendation of the War Food Administration, largely because of Austin's work in connection with the War Production Board.

Austin's latest affiliation with the project he helped build was last January when, in cooperation with Oklahoma's Governor Robert S. Kerr, he sponsored an inspection of the State's first and only Federal reclamation venture. The event attracted farmers and reclamation enthusiasts from many points in the Southwest. His last public appearance was in August when he assisted Governor Kerr in making a motion picture of the project.

Survivors include his widow, Mrs. W. C. Austin, Altus, Okla.; three daughters, Mrs. Pat O'Byrne, Kansas City, Mo.; Mrs. Harry Ware, Wytheville, Va.; and Miss Harriett Austin, Altus, Okla.; and two sons, Lowell Austin, Bureau employee, Altus, Okla., and Commander Harlan Austin, New London, Conn.

Bureau Gets WRA Facilities

Allocations of real and personal property located on War Relocation Authority centers at Klamath-Tule Lake, Shoshone-Heart Mountain, and Minidoka-Hunt and acquired by the Bureau of Reclamation from the WAA will be completed as follows: to municipalities and nonprofit organizations, by October 15; for veteran settlement and Reclamation project use, by November 18.

Successful entrymen on Reclamation public land projects will be advised of the availability of materials from the relocation centers and how they can procure what of them they need.

Riter Appointed Chairman of Engineering Committee

Chief of Hydrology J. R. Riter, Bureau of Reclamation, was selected as chairman of the permanent engineering committee appointed by the Upper Basin Compact Commission at its second meeting at Santa Fe, N. Mex., September 17–18. The principal function of the engineering committee is to gather, analyze, and report the basic engineering data necessary to formulation of the compact. In place of a single meeting, the Compact Commission will hold next a series of hearings at Rock Springs, Wyo.; Grand Junction, Colo.; Price, Utah; and Farmington, N. Mex., beginning the latter part of October and extending through early November.

Notes to Contractors

Contracts Awarded During October 1946

Spec. No.	Project	Date of award	Description of work	Contractor's name and address	Contract amount
1214[1]	Davis Dam, Ariz.	Oct. 18	Electrical equipment for Phoenix and Tucson substations.	Westinghouse Electric Corp., Denver, Colo.	$69,768.12
1288[2]	Boulder Canyon, Nev.	Oct. 8	Electrical equipment for Boulder City substation.	General Electric Co., Denver, Colo.	14,301.18
1332[3]	Columbia Basin, Wash	Oct. 7	3 turbines, units R-1, R-2, R-3, Grand Coulee.	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	2,213,800.00
1332[4]	do	Oct. 7	3 governors, units R-1, R-2, R-3, Grand Coulee.	Woodward Governor Co., Rockford, Ill.	121,200.00
1336	Boise-Payette, Idaho	Oct. 10	4 motors for "C" Line Canal pumping plant.	Electric Machinery Co., Minneapolis, Minn.	67,395.00
1338	Columbia Basin, Wash	Oct. 25	12 pump discharge pipes, Grand Coulee pumping plant.	Western Pipe & Steel Corp. of California, San Francisco, Calif.	1,208,000.00
1339	do	Oct. 1	3 generators for units R-1, R-2, R-3, Grand Coulee.	Westinghouse Electric Corp., Denver, Colo.	3,290,000.00
1353	Deschutes, Oreg.	Oct. 23	Construction 11.2 miles North Unit Main Canal.	Adler Construction Co., Seattle, Wash	602,832.50
1365[3]	Provo River-Deer Creek, Utah.	Oct. 18	1 pump and turbine, Jordon Narrows pump.	James Leffel & Co., Springfield, Ohio	18,921.00
1373[5]	Columbia Basin, Wash	Oct. 15	Construction of one motor for Grand Coulee pumping plant.	General Electric Co., Denver, Colo.	854,522.00
1373[6]	do	Oct. 15	Construction of two motors for Grand Coulee pumping plant.	Westinghouse Electric Corp., Denver, Colo.	1,620,026.00
1384	do	Oct. 10	3 transformers for unit L-9, Grand Coulee power.	do	154,915.30
1394	do	Oct. 18	One 70-ton gantry crane Grand Coulee pumping plant.	Star Iron & Steel Co., Tacoma, Wash.	127,300.00
1400	do	Oct. 24	Construction of Potholes Dam	C. F. Lytle Co., Green Construction Co., and Amis Construction Co., Sioux City, Iowa.	9,359,011.00
1401	do	Oct. 25	Construction of Long Lake Dam	J. A. Terteling & Sons, Inc., Boise, Idaho.	1,770,592.00
1403[7]	Central Valley, Calif.	Oct. 10	Pipes, fittings, and valves, Keswick powerplant.	Western Piping & Engineering Co., San Francisco, Calif.	43,590.00
1405	Boise-Payette, Idaho	Oct. 22	Preparation of concrete aggregates.	Quinn Robbins & Co., Boise, Idaho.	23,125.00
1407	Davis Dam, Ariz.	Oct. 10	1 synchronous condenser, Tucson	General Electric Co., Denver, Colo.	149,984.00
1413	Boise-Payette, Idaho	Oct. 22	Construction Black Canyon "C" transmission line.	S. H. Reither, Aitkin, Minn.	53,193.13
1418[8]	Columbia Basin, Wash	Oct. 9	2 synchronous motors, Pasco pumping plant.	Elliot Co., Jeannette, Pa.	27,730.00
1424	Rio Grande, N. Mex.	Oct. 23	Construction Alamogordo-Hollywood transmission line.	Reynolds Electric & Engineering Co., El Paso, Tex.	156,790.04
1431	Missouri Basin-Kortes, Wyo.	Oct. 23	3 transformers for Kortes powerplant.	Pennsylvania Transformer Co., Pittsburgh, Pa.	127,174.00
1447	Altus, Okla	Oct. 24	Construction 14.7 miles Ozark Canal.	Stebbins Construction Co., Tulsa, Okla	319,719.20
1451	Boise-Payette, Idaho	Oct. 30	One 12-inch-diameter penstock, Cascade Dam outlet.	American Pipe & Construction Co., Portland, Oreg.	13,940.00
1456[3]	Klamath-Tule Lake, Oreg.	Oct. 25	3 synchronous motors, Modoc unit	General Electric Co., Denver, Colo.	29,495.24
1470	Davis Dam, Ariz.	Oct. 9	1 panel extension to control board, Parker.	Westinghouse Electric Corp., Denver, Colo.	10,693.00

[1] Schedules 1 and 4.
[2] Schedules 1, 2, 6, 7.
[3] Schedule 2.
[4] Schedule 4.
[5] Item 1.
[6] Items 2 and 3.
[7] Item 2.
[8] Schedule 1.

NOTE. The above contracts qualify under the provisions of the Office of War Mobilization and Reconversion Directive 128 in that all such contracts are for work on projects commenced prior to Aug. 5, 1946.

Construction and Supplies for Which Bids Will be Requested During December 1946

Estimated date bids to be invited	Estimated bid opening date	Project	Description of work or material
Dec. 2	Jan. 6	Central Valley—Friant, Calif.	32- by 20-feet radial gate, Kings River siphon, Friant—Kern Canal.
Dec. 3	Jan. 7	Shoshone, Wyo.	Earthwork and structures, Ralston lateral, station 0+84.12 to 230+52.57.
Dec. 3	Jan. 7	Yakima—Roza, Wash.	Earthwork and structures, for lateral distribution system, pump area 8.
Dec. 5	Jan. 9	Gila, Ariz.	Earthwork and structures, laterals from "A and B" canals, completion of "A" canal bridges.
Dec. 10	Jan. 14	Klamath—Tule Lake, Oreg.	Earthwork and structures, laterals and drains, Coppeck Bay area, lining "M" canal.
Dec. 16	Jan. 20	Central Valley—Friant, Calif.	Three 15,000-pound radial gate hoists, Friant-Kern Canal.
Dec. 16	Jan. 20	Central Valley—Delta, Calif.	Six 22,500-horsepower motors for pumps in Delta-Mendota pumping plant.
Dec. 16	Jan. 20	Colorado-Big Thompson, Colo.	Granby Dam radial gate hoist.
Dec. 23	Jan. 27	Deschutes, Oreg.	Lumber, North Unit Main Canal, station 2377+29.94.
Dec. 30	Feb. 3	Colorado-Big Thompson, Colo.	Pump discharge valve operating mechansim, Granby pumping plant.

U. S. GOVERNMENT PRINTING OFFICE: 1946

Turkey in the Tree

Holiday season and a wild turkey less than 50 yards away! But Colorado's open season on wild turkey had not arrived and Regional Geologist J. Neil Murdock of the Bureau's Salt Lake City, Utah, office, reached for his trusty old 5 by 7 view camera instead of his flintlock. The result was this unusual shot, taken when Murdock was returning from a reconnaissance examination of the O'Neal Reservoir site, 35 miles east of Durango, Colo., near the San Juan River.

PASCO UNIT PROVING GROUND

The Pasco unit of the Columbia Basin project, destined to be the first land to receive water in the Bureau of Reclamation's million-acre development, is attracting attention not only because of this fact, but because of its unusual lateral system and its "laboratory" nature.

Now under construction more than 100 miles south of the Grand Coulee Dam, the main lateral, resembling a figure 6, will loop back on a portion of itself and empty into itself. A relief pump will do the trick. This pump, to be located about two-thirds of the way along the 9.4-mile main lateral, will boost the water 30 feet. At the relift point, the lateral will be reduced in size from 119 cubic feet per second capacity to 58 cubic feet, according to Resident Engineer C. W. Seeholzer.

In addition to the main relift, the Pasco unit will have several relift pumps along its sublaterals to carry water to land lying at higher elevations.

The Pasco area borders along the Columbia River and will receive its water by pumping directly from the Columbia. Like virtually all the land in the basin, it is extremely dry; so dry, in fact, that about 40 gallons of water are required to make 1 cubic yard of earth sufficiently moist for compacting into canal embankments. Moisture content of the soil averages approximately 3 percent, compared with the optimum of about 15 percent, Seeholzer says.

Construction of the 23 miles of laterals and wasteways necessary to serve the 5,397 acres in the Pasco unit is being pushed by J. A. Terteling & Sons, Inc., of Boise, Idaho, under a $714,223 contract. The James Construction Co. of Seattle is building a $188,000 pumping plant on the east bank of the Columbia River, the water surface of which is approximately 170 feet lower than the lands to be irrigated. The contractors expect to finish the job next summer if materials are available.

Because the Pasco unit will receive water several years before the project lands nearest the principal irrigation system now under construction 100 miles to the north, it will help serve as a proving ground for the project.

For example, various types of lining will be used on the Pasco laterals to determine the best material for lining sections of the principal canal system. Concrete, asphalt, and pneumatically applied mortar will be the materials tested.

Columbia Basin project officials also will keep close check on the water-holding capacities and productiveness of the various soil types, soil erosion resulting from farm irrigation ditches, wind erosion of the soils, and weed-control measures along laterals. The chief weed-control measure planned is the growing of grass on canal banks above the canal linings.

First water may be flowing to the family-size farms in the Pasco unit by next summer. These units, 79 in number, conform with a topographically controlled system proposed for adoption throughout the million-acre project. Farm boundaries at Pasco are determined principally by such topographical features as gullies, roads, railways, and canals to make irrigation farming easier and more economical.

Steel Detecting

(Continued from page 268)

approximate location and direction of the reinforcing bars in the concrete under investigation are known from design drawings, the electromagnet is held against the concrete face so that it is parallel to the bars and moved slowly in a direction perpendicular to their axis. As the magnet passes over a bar, a signal of increased intensity will be heard in the earphones, the point of maximum signal indicating the position of the bar. If design information is not available the location of reinforcing bars can be just as definitely fixed; however, a preliminary determination must be made of the direction of the reinforcing bars. This may be ascertained by slowly revolving the magnet in a circle until maximum signal is obtained, and then proceeding as previously described.

In making laboratory tests of the detector, two concrete slabs, both 8 inches in thickness, were prepared for the tests. One slab contained 1-inch round and 1-inch square reinforcing bars with the vertical bars being located $4^{3}/_{4}$ inches and $2^{1}/_{4}$ inches in depth from the opposite faces of the slab, and the horizontal bars in contact with the next bars. The position of the vertical bars was located within a 1-inch error from the center line of the bars and with equal facility from either side of the slab. The 4-inch spacing used, which afforded an actual clear interval between bars of only 3 inches, was found to be too close to permit any separation.

In the other slab, one-half-inch round bars on 12-inch spacing both ways, were embedded so that the vertical bars were respectively 2 and 6 inches from opposite faces of the slab. The bars on the side with the 2-inch depth were easily located with one-half-inch error. At the 6-inch depth, considerably more care in adjustment was required, but they were also located within an error of 1 inch. Borings were made into the concrete to check the detector indications.

Our Back Cover

Photograph by J. E. Fluharty, Region II

JUNIOR SUPERINTENDENT

Little Johnny watches Dad carefully hoeing even rows which give his irrigation farm on the Klamath project that well groomed look.

·27.5:32 index (Note: No more publications for the duration April, 1942, being the last issue).

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THE RECLAMATION ERA, VOLUME XXXII

January to April 1942

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